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**State of California
Arnold Schwarzenegger, Governor**

Approved: _____ Date: _____

**Resources Agency
Mike Chrisman, Secretary**

**Department of Fish and Game
John W. McCamman, Acting Director**



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TABLE OF CONTENTS

ACKNOWLEDGMENTS	IV
ACRONYM GLOSSARY	V
EXECUTIVE SUMMARY	XI
1. INTRODUCTION	1
2. AIS ECOLOGICAL & ECONOMIC IMPACTS	7
3. VECTORS OF AIS	16
Vector 1. Commercial Shipping.....	19
Vector 2. Commercial Fishing	21
Vector 3. Recreational Equipment & Activities	22
Vector 4. Trade in Live Organisms.....	23
Vector 5. Construction in Aquatic Environments	27
Vector 6. Water Delivery & Diversion System	27
4. MANAGEMENT FRAMEWORK	29
General Framework	29
An Overview of Current AIS Management Activities in California	35
Gaps & Challenges	45
5. SUMMARY OF AIS LAWS, REGULATIONS & AUTHORITIES	46
6. MANAGEMENT OBJECTIVES, STRATEGIES & ACTIONS	50
OBJECTIVE 1: COORDINATION & COLLABORATION.....	53
OBJECTIVE 2: PREVENTION	63
OBJECTIVE 3: EARLY DETECTION & MONITORING	75
OBJECTIVE 4: RAPID RESPONSE & ERADICATION.....	79
OBJECTIVE 5: LONG-TERM CONTROL & MANAGEMENT	82
OBJECTIVE 6: EDUCATION & OUTREACH.....	86
OBJECTIVE 7: RESEARCH	93
OBJECTIVE 8: LAWS & REGULATIONS	96
7. PRIORITIES, IMPLEMENTATION & PLAN EVALUATION	98
8. CASE STUDIES IN ERADICATION & CONTROL	117
1. CAULERPA.....	117
2. SMOOTH CORDGRASS	119
3. BRAZILIAN ELODEA	123

4. EURASIAN WATERMILFOIL	127
5. OTHER AIS SPECIES OF CONCERN	129
9. LITERATURE CITED	132
FIGURES	
1: Nonindigenous Species Surveys from California Harbors & Bays....	4
2: AIS Invasion Progression, Management and Cost.....	15
3: Wetted Surface Area	21
4: Ballast Water Reporting and Discharge Rates	42
5: AIS Coordinating Structure.....	58
TABLES	
1: CAISMP Action Summary	xi
2: Common Bioinvasion Vectors	17
3: Species Management Types.....	31
4: Lead AIS Agency Contacts in California.....	37
5: CAISMP Implementation Table	100
6: Funds Spent on Ongoing AIS Programs and Activities	114
APPENDICES	
A: Draft California Rapid Response Plan	2
B: Federal Authorities, Legislation & Agencies.....	26
C: State Authorities, Legislation & Agencies	37
D: Other AIS Interests: Coordinating Committees, Educational Initiatives & Special Interest Groups	46
E: AIS Plan Development & Process	53
F: Executive Summary of <i>Biological Invasions: Recommendations for U.S. Policy and Management,</i> Position Paper of Ecological Society of America	71
G: List of Regulated Species in California	74

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2007 Plan

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ACRONYM GLOSSARY

This section describes acronyms and other terms concerning entities involved in AIS management, species names used in this plan and a brief glossary.

Acronyms*

AE	Agency Executives (Upper management of state agencies and departments)
AISWG	Aquatic Invasive Species Working Group (see Action 1A3)
ANSTF	Aquatic Nuisance Species Task Force
BML	Bodega Marine Lab
BOE	Board of Equalization
CAAIST	California Agencies Aquatic Invasive Species Team (see Action 1A2)
CAC	County Agricultural Commissioners
CACASA	California Agricultural Commissioners and Sealers Association
CAISMP	California Aquatic Invasive Species Management Plan
CALFED	CALFED Bay-Delta Program
CBC	California Biodiversity Council
CCC	California Coastal Conservancy
CDF	California Department of Forestry and Fire Protection
CeNCOOS	Central and Northern California Ocean Observing System
DBW	California Department of Boating and Waterways
DESP-UCD	Department of Environmental Science and Policy, University of California, Davis
DFG	California Department of Fish and Game
/OSPR	/Office of Spill Prevention and Response
DFA	California Department of Food and Agriculture
DHS	California Department of Health Services
DOE	California Department of Education
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
FA	Federal Agencies
FY	State fiscal year (July 1 through June 30)
ISAC	United States Invasive Species Advisory Committee
ISP	San Francisco Estuary Invasive <i>Spartina</i> Project
NGOs	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NPDES	National Pollutant Discharge Elimination System
OPC	California Ocean Protection Council
PARKS	California Department of Parks and Recreation
PBWG	Pacific Ballast Water Group
PSMFC	Pacific States Marine Fisheries Commission
RCD	Resource Conservation District
RI	Research Institutions, universities and affiliated programs
RWQCB	Regional Water Quality Control Board
SCC	State Coastal Conservancy
SCCOOS	Southern California Coastal Ocean Observing System
Sea Grant	California Sea Grant College Program
SFEP	San Francisco Estuary Project
SH	Stakeholders
SLC	California State Lands Commission
SWRCB	State Water Resources Control Board
TRPA	Tahoe Regional Planning Agency
TRCD	Tahoe Resource Conservation District
UCCE	University of California Cooperative Extension
USDA	United States Department of Agriculture

/ARS	/Agricultural Research Service
/APHIS	/Animal and Plant Health Inspection Service
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WRP	Western Regional Panel

** Acronyms are used largely after the first appearance of an agency name within a chapter. Full names are often spelled out again in subsequent chapters if it has been many pages since the prior mention or if the full name is central to the information presented.*

Important Terms

These terms are used throughout, but especially in Chapter 6 and in the Table 5: CAISMP Implementation Matrix.

Implementing Entity: Since this is a state plan, these are state agencies, programs within state agencies, or groups that include state agencies that fund and have primary accountability and authority for an action being carried out. In Chapter 6, the Implementing Entity appears in **BOLD**. This term is also used in the Implementation Table in Chapter 7.

Cooperating Organizations: Entities whose participation is needed or may be needed to conduct an action. In Chapter 6, cooperating organizations appear in regular, non-bold, type.

Non-governmental Organizations (NGOs): Non-profit organizations directly involved in AIS research or control activities.

Stakeholders: Relevant recreation, industry, local government, landowner representatives and special interest groups.

Plan Implementation and Science Advisory Panels: Panels created per Action 1A5 to help the work of the CAAIST and AISWG.

Species Names

All species names mentioned in this document appear below in full, with their scientific names for reference. Common names are used throughout the document, except in those cases where the scientific name has become the preference for common use (*Arundo*, *Egeria*, *Hydrilla*, *Caulerpa*, etc.). All names appear in full in Appendix G, the Regulated Species List, for the purposes of regulatory clarity.

Invasive Species

1. African clawed frog, *Xenopus laevis*
2. Alligatorweed, *Alternanthera philoxeroides*
3. Asian overbite clam, *Corbula amurensis**
4. Asian swamp eel, *Monopterus albus*
5. Atlantic salmon, *Salmo salar*
6. *Botrylloides diegensis*
7. Brazilian elodea, *Egeria densa* (most commonly called *Egeria*)
8. Bullfrog, *Rana catesbeiana*
9. *Caulerpa taxifolia* (most commonly called *Caulerpa*)
10. Channeled apple snail, *Pomacea canaliculata*
11. Chinese mitten crab, *Eriocheir sinensis*
12. Curly pondweed, *Potamogeton crispus*
13. Dwarf eelgrass, *Nanozostera japonica*
14. English cordgrass, *Spartina anglica*
15. Eurasian watermilfoil, *Myriophyllum spicatum*
16. European frogbit, *Hydrocharis morsus-ranae*
17. European green crab, *Carcinus maenas*
18. Giant reed, *Arundo donax* (most commonly called *Arundo*)
19. Giant salvinia, *Salvinia molesta*
20. Golden mussel, *Limnoperna fortunei*
21. Green sunfish, *Lepomis cyanellus*
22. *Hydrilla verticillata* (most commonly called *Hydrilla*)
23. Japanese seaweed, *Sargassum muticum*
24. Knotted wrack, *Ascophyllum nodosum*
25. Melaleuca, *Melaleuca quinquenervia*
26. *Microcystis* spp.
27. Mosquitofish, *poeciliids*
28. New Zealand mudsnail, *Potamopyrgus antipodarum*
29. Northern Pacific seastar, *Asterias amurensis*
30. Northern pike, *Esox lucius*
31. Northern snakehead, *Channa argus*
32. Paleyellow iris, *Iris pseudacorus*
33. Parrot feather milfoil, *Myriophyllum aquaticum*
34. Perennial pepperweed, *Lepidium latifolium*
35. Purple loosestrife, *Lythrum salicaria*
36. Quagga mussel, *Dreissena bugensis*
37. Sabellid polychaete, *Terebrasabella heterouncinata*
38. Sacramento pikeminnow, *Ptychocheilus grandis*
39. Saltcedar, *Tamarix ramosissima*
40. Saltmeadow cordgrass, *Spartina patens*
41. Sea lamprey, *Petromyzon marinus*
42. Shimofuri goby, *Tridentiger bifasciatus*
43. Shipworm, *Teredo navalis*
44. Small cordgrass, *Spartina maritima*
45. Smooth cordgrass, *Spartina alterniflora*
46. Wakame, *Undaria pinnatifida*
47. Water hyacinth, *Eichhornia crassipes*
48. Water lettuce, *Pistia stratiotes*
49. Yellowfin goby, *Acanthogobius flavimanus*

50. Yellow floating heart, *Nymphoides peltata*
51. Zebra mussel, *Dreissena polymorpha*

Native Species

1. Brown turban snails, *Tegula brunnea*
2. California clapper rail, *Rallus longirostris obsoletus*
3. Chinook salmon, *Oncorhynchus tshawytscha*
4. Dungeness crabs, *Cancer magister*
5. Delta smelt, *Hypomesus transpacificus*
6. Giant kelp, *Macrocystis pyrifera*
7. Green sturgeon, *Acipenser medirostris*
8. Pickleweed, *Salicornia* spp
9. Salt marsh harvest mouse, *Reithrodontomys raviventris*
10. Soft bird's-beak, *Cordylanthus mollis* ssp. *mollis*
11. Steelhead trout, *Oncorhynchus mykiss*

* This document refers to the locally known "Asian clam" as the "Asian overbite clam." Many scientists have begun to call it the "overbite" clam to distinguish it from other invasive clams from the Far East. The species' scientific name is due to be officially modified from *Potamocorbula amurensis* to *Corbula amurensis* in the forthcoming *Light's Manual* and many scientists have begun to use the shorter species name. Other literature citations for the name change can be found on page 5 of the following:

http://www.iep.ca.gov/report/newsletter/2005_newsletters/IEPNews_spring2005final.pdf

Glossary

Accidental introduction: An introduction of nonindigenous species that occurs as the result of activities other than the purposeful or intentional introduction of the species involved, such as the transport of nonindigenous species in ballast water or in water used to transport fish, mollusks or crustaceans for aquaculture or other purposes.

Biocontrol: The use of living organisms, such as predators, parasites and pathogens, to control pest animals (e.g. insects), weeds or diseases.

Ballast water: Any water and associated sediments used onboard a ship to increase the draft, change the trim, regulate the stability or maintain the stress loads of the vessel.

Control: Eradicating, suppressing, reducing or managing invasive species populations, preventing spread of invasive species from areas where they are present and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.

Cryptogenic species: An organism of unknown origin; may be introduced or native.

Ecological integrity: The extent to which an ecosystem has been altered by human behavior; an ecosystem with minimal impact from human activity has a high level of integrity; an ecosystem that has been substantially altered by human activity has a low level of integrity.

Eradicate: For the purpose of this plan, eradication is the complete elimination of an invasive species from a specific part of California or the entire state.

Established: An introduced organism with a permanent population(s), i.e., one that has the ability to reproduce and is not likely to be eliminated by humans or natural causes.

Exotic: Any species or other variable biological material that enters an ecosystem beyond its historic range, including such organisms transferred from one country to another. Also known as nonindigenous or non-native.

Fouling: An accumulation of organisms that attaches to naturally occurring and manmade submerged hard surfaces such as rocks, shells, ships, intake pipes, and other submerged equipment or machinery. Mobile organisms that may be tucked in nooks created by the larger animals are also considered part of the “fouling community”.

Genetic dilution: Genetic dilution occurs when introduced organisms add their genetic material to native populations through hybridization. This can result in populations that are less well adapted to their environment, potentially leading to the decline of those populations.

Host: A living animal or plant that supports parasitic animals, plants or microbes, internally or on its surface.

Incipient infestation: A small colony of an invasive species that has spread to a new area.

Intentional introduction: All or part of the process by which a nonindigenous species is purposefully introduced into a new area.

Introduction: The intentional or unintentional escape, release, dissemination or placement of a species into a California ecosystem as a result of human activity.

Invasive species: For the purpose of this plan, the term refers to species that establish and reproduce rapidly outside of their native range and may threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat. Through their impacts on natural ecosystems, agricultural and other developed lands, water

delivery and flood protection systems, invasive species may also negatively affect human health and/or the economy.

Keystone species: A species whose loss would have a disproportionately large effect on its ecosystem relative to its abundance.

Native species: A species within its natural range or natural zone of dispersal, i.e., within the range it would or could occupy without direct or indirect introduction and/or care by humans.

Non-native or Nonindigenous species: A species that enters an ecosystem beyond its historic geographic range. Also known as exotic or alien species. Other taxa can be considered non-native or nonindigenous, such as families, genera, subspecies or varieties.

Nuisance species: For the purpose of this plan, the term is synonymous with invasive species.

Pathogen: A microbe or other organism that causes disease.

Pathways: Natural and human connections that allow movement of species or their reproductive propagules from place to place.

Pioneer infestation: See incipient infestation.

Taxa: Taxa are groups used to classify organisms (e.g. kingdom, phylum, class, order, family, genus and species). Taxa is the plural form of taxon.

Vector: Vector is synonymous with “pathway,” see definition above. As such, vector is defined more broadly in this report than in its narrower more common definition as a pathway solely for pathogens.

Watershed: The geographic area that drains to a single water body or hydrographic unit such as a lake, stream reach or estuary.

EXECUTIVE SUMMARY

Invasion of California Waters

Californians have benefited from the introduction to this state of various fish, plants and other species necessary for food or other human pursuits; however, there are many other introduced species that can wreak havoc on the state's environment and economy. Those species that cause harm and spread quickly from their point of introduction are often called "invasive." For these species, a single individual may produce thousands of seeds, masses of larvae or reproduce from nothing bigger than bits of stems, roots or leaves. Those that live in or near the water – aquatic invasive species – can be easily dispersed to distant water bodies or new ecosystems by currents, tides, river flows, streams, floods and other water flows.

This plan proposes management actions for addressing **aquatic** invasive species (AIS) threats to the State of California. It focuses on the non-native algae, crabs, clams, fish, plants and other species that continue to invade California's creeks, wetlands, rivers, bays and coastal waters. State surveys indicate that at least 607 species of aquatic invaders can be found in California's estuarine waters. These invaders cause major impacts: disrupting agriculture, shipping, water delivery, recreational and commercial fishing; undermining levees, docks and environmental restoration activities; impeding navigation and enjoyment of the state's waterways; and damaging native habitats and the species that depend on them. As the ease of transporting organisms across the Americas and around the globe has increased, so has the rate of AIS introductions.

Vectors & Entry Points

Transoceanic shipping is a major source of AIS invaders. The state estimates that about 9.1 million metric tons of ballast water was discharged in California waters in 2005. Hull fouling may rival ballast water discharge as a leading historical cause of harmful AIS introductions. AIS can also be transported from place to place via other pathways or vectors. Invasive species can cling to recreational gear, fishing equipment, drilling platforms, floating debris and docks. They may escape or be released into state waters from aquaculture packing materials, ornamental ponds and aquariums. Shoreline restoration and construction projects, as well as water-based scientific research, also transport species. The threat of aquatic invasions poses major challenges to California's aquatic systems managers and policy makers. Resources must be devoted to preventing new introductions as well as to containing existing populations. Current state resources and programs are far from adequate to perform this task.

Need for Statewide Action

Though a number of state agencies have been individually addressing AIS concerns or coordinating on individual projects, the scope of the problem has now reached a scale, complexity and cost requiring a more comprehensive statewide approach. Thus, the main purpose of this new California plan is to coordinate state programs, create a statewide decision-making structure and provide a shared baseline of data and agreed-upon actions so that state agencies may work together more efficiently. While the plan recognizes and provides for coordination with the federal, regional, local, private and nonprofit efforts to manage AIS, its central actions concern internal state coordination. As such, the plan ensures state action on high priority activities, improves utilization of scarce state resources and helps bridge gaps in coverage. Plan development was directed by the California Department of Fish & Game and includes input from state agencies involved in AIS management, as well as from the public and stakeholders, over a period of five years.

Plan Goals & Chapters

The plan's overall goal is to identify the steps that need to be taken to minimize the harmful ecological, economic and human health impacts of AIS in California. The plan contains background chapters on AIS environmental and economic impacts. It describes vectors of AIS entry into the state including, but not limited to, commercial shipping, trade in live organisms, construction in aquatic habitats, and water deliveries and diversions. Subsequent chapters explain how AIS are managed in general and what the state has been doing to manage them to date. In addition, case studies for managing four specific AIS appear in the last chapter of this plan.

Beyond this background information and context, the heart of the plan lies in 163 different management actions organized under eight objectives (Table 1):

1. Coordination & Collaboration
2. Prevention
3. Early Detection & Monitoring
4. Rapid Response & Eradication
5. Long-term Control & Management
6. Education & Outreach
7. Research
8. Laws & Regulation

The interagency process of developing and discussing each of these actions, and deciding which entities will undertake them, provides a strong foundation for improving state management and coordination in the years ahead. It also supports the state's first rapid response process for high-risk invaders, which is detailed in Appendix A of this plan.

Current Priorities

The highest priorities among the 163 actions identified in this plan are as follows:

1. Formalize the creation of two major new coordinating entities, one entirely for state agencies and one for a broader range of AIS interests (Action 1A2 and 1A3).
2. Formalize a process for the team of state AIS managers to share information with and get input from agency executives (Action 1A1).
3. Secure funding for state AIS staff (Action 1C3).
4. Conduct a statewide assessment of the risk from four specific AIS vectors: commercial fishing, recreational boating, live bait, and live imported seafood (Actions 2B7, 2C1, 2D1, and 2D4).
5. Fund and launch early detection and rapid response actions, including efforts to coordinate various AIS monitoring programs and expand monitoring of freshwater systems (Strategies 3A and 4A, and Appendix A).

If these core actions can be accomplished, it will provide a basis for pursuing the larger list of AIS management priorities in the future.

Conclusion

Aquatic invasive species are already a serious problem for California. Invasions around the world suggest that environmental and economic impacts from AIS will soon become much greater. This plan provides the state's first comprehensive, coordinated effort to prevent new invasions, minimize impacts from established AIS and establish priorities for action statewide. In addition, it proposes a process for annual plan evaluation and improvement so that AIS can continue to be managed in the most efficient manner in the future.

Table 1: CAISMP Action Summary

The actions described in this table are abbreviated to provide a summary. See Chapter 6 for complete and accurate language of these actions.

OB1: COORDINATION & COLLABORATION

Internal State Coordination

- 1A1. Develop an executive level consultation process.
- 1A2. Formalize the California Agencies AIS Team (CAAIST).
- 1A3. Establish, fund and staff an Aquatic Invasive Species Working Group (AISWG).
- 1A4. Evaluate the need for an invasive species center.
- 1A5. Form and fund technical advisory panels.
- 1A6. Draft and update a list of AIS at high risk for introduction.
- 1A7. Identify lead state agency for particular AIS, water bodies and invasion vectors.
- 1A8. Identify agency personnel required for AIS management.
- 1A9. Improve state websites related to AIS.
- 1A10. Assess effectiveness of and gaps in state AIS programs.
- 1A11. Coordinate AIS management with SWRCB & RWQCBs.
- 1A12. Develop and update AIS expert list.
- 1A13. Develop boilerplate AIS language for official agency comments.

Local, Nat'l & Int'l Coordination

- 1B1. Identify AIS reps in government agencies and NGOs.
- 1B2. Identify conflicts and overlaps among government and NGO AIS programs.
- 1B3. Invite community groups for AIS planning and education.
- 1B4. Expand participation in local AIS efforts and task forces.
- 1B5. Expand participation in regional, national and international AIS task forces.
- 1B6. Partner with Mexico, Canada, Pacific Coast and Colorado River states.
- 1B7. Participate in national and international conferences.

Funding

- 1C1. Identify and apply for state and national grant funding.
- 1C2. Establish stable, long-term funding to help implement this plan.

- 1C3. Provide state funding for AIS positions.
- 1C4. Provide funding for AIS rapid response actions.
- 1C5. Hire a funding development specialist.
- 1C6. Provide new funding mechanisms.

OB2: PREVENTION

Regional Vector Assessment

- 2A1. Rank AIS vector importance in different regions of California.

Commercial Vessels & Maritime Activities

- 2B1. Quantify ballast water and hull fouling vectors and assess invasion risk.
- 2B2. Continue and improve state ballast water inspection and enforcement program.
- 2B3. Implement discharge standards for treated ballast water.
- 2B4. Identify and address gaps in Marine Invasive Species Act.
- 2B5. Develop a commercial vessel fouling outreach and management program.
- 2B6. Investigate how moving maritime structures can contribute to AIS dispersal.
- 2B7. Quantify and assess the role of commercial fishing vessels as AIS vectors.
- 2B8. Develop a commercial fishing outreach and management program.

Recreation

- 2C1. Quantify and assess recreational boating as an AIS vector.
- 2C2. Develop a recreational boating outreach and management program.
- 2C3. Develop a watercraft inspection program for high priority boat launch sites.
- 2C4. Quantify and assess recreational fishing as an AIS vector.
- 2C5. Develop a recreational fishing outreach and management program.
- 2C6. Develop guidelines for: disposal of invasive species at marinas; cleaning of fishing gear and equipment; disposal of live bait.

Bait, Seafood, Aquaculture & Aquarium

- 2D1. Quantify and assess bait as an AIS vector.
- 2D2. Work with the bait industry to develop prevention strategies.
- 2D3. Develop a bait outreach and management program.
- 2D4. Quantify and assess imported seafood as an AIS vector.
- 2D5. Work with the live seafood industry to develop preventative strategies.
- 2D6. Develop an imported seafood outreach and management program.
- 2D7. Assess risks posed by water handling systems.
- 2D8. Educate aquaculture industry on containment systems.
- 2D9. Develop an aquaculture outreach and management program.
- 2D10. Quantify and assess how aquarium and aquascaping trades contribute to AIS introductions.
- 2D11. Work with aquarium, water garden and other industries on accessible disposal.
- 2D12. Implement an aquarium and aquascaping outreach and management program.

Fisheries Enhancement

- 2E1. Quantify and assess fisheries enhancement as an AIS vector.
- 2E2. Review DFG practice of intentional introductions of non-native species for recreational purposes.
- 2E3. Reduce unauthorized stocking of non-native species.
- 2E4. Weigh benefits of mosquito-fish introduction.

Research, Management & Education

- 2F1. Quantify and assess research, resource management and educational activities as AIS vectors.
- 2F2. Establish protocols to minimize spread of AIS by these activities.
- 2F3. Evaluate regulations and protocols for in-water research.
- 2F4. Quantify and assess live aquatic species shipments for research as an AIS vector.

Table 1: CAISMP Action Summary (continued)

Construction & Restoration

- 2G1. Quantify and assess construction activities as an AIS vector.
- 2G2. Work with industry to develop equipment decontamination guidelines.
- 2G3. Develop a construction outreach and management program.
- 2G4. Quantify and assess restoration activities as an AIS vector.
- 2G5. Encourage the use of native species.
- 2G6. Develop a restoration outreach program.

Water Diversion

- 2H1. Quantify and assess the water delivery and diversion system as an AIS vector.
- 2H2. Develop an outreach and management program for the system.

Enforcement & Inspection

- 2I1. Increase staffing and hours at DFA Border Protection Stations.
- 2I2. Develop guidelines for border inspections.
- 2I3. Increase DFG enforcement of current regulations on prohibited and restricted species.
- 2I4. Ensure adequate staffing and cargo inspection guidelines for port and airport enforcement.
- 2I5. Continue disease sampling for shipments and stocks of live aquatic species.
- 2I6. Identify mail order, online vendors selling California prohibited and restricted species.

OB3: EARLY DETECTION & MONITORING

Early Detection

- 3A1. Assess current monitoring of state waters for early detection opportunities.
- 3A2. Assess how the state's Marine Invasive Species Program monitoring can aid early detection.

- 3A3. Develop a statewide approach to early detection.
- 3A4. Outreach to those regularly sampling state waters.
- 3A5. Create and train a statewide citizen monitoring network.
- 3A6. Engage professional divers in early detection network.
- 3A7. Review efficacy of the state's AIS early detection systems.

Long-Term Monitoring

- 3B1. Assess long-term AIS monitoring of state waters.
- 3B2. Coordinate with ocean observing groups.
- 3B3. Monitor locations with a high invasion rate.
- 3B4. Monitor the population growth and dispersal of established AIS.
- 3B5. Fund the incorporation of DFG's historical stream surveys and report findings into a central database.
- 3B6. Include maps of existing AIS in California waters in the DFG BIOS system.
- 3B7. Review the efficacy of long-term monitoring systems.

OB4: RAPID RESPONSE & ERADICATION

Rapid Response

- 4A1. Develop and implement a statewide rapid response plan.
- 4A2. Evaluate and coordinate existing systems for reporting AIS sightings.
- 4A3. Develop species- and/or location-specific rapid response plans.
- 4A4. Explore permanent funding for rapid response.

Eradication

- 4B1. Review effectiveness of eradication programs.
- 4B2. Continue and complete current eradication efforts.
- 4B3. Standardize criteria for identifying priority species for eradication.
- 4B4. Develop a method to prioritize sites of AIS invasion concern.
- 4B5. Identify ecologically sensitive waters requiring additional precautions.

OB5: LONG-TERM CONTROL & MANAGEMENT

Control

- 5A1. Develop a method or criteria to prioritize control actions.
- 5A2. Prioritize control efforts for existing and new organisms of concern.
- 5A3. Continue ongoing control programs.
- 5A4. Develop species- and site-specific control plans.
- 5A5. Provide technical assistance to watershed councils, irrigation districts and other groups.

Limit Dispersal to New Areas

- 5B1. Establish boat washing stations and disposal facilities at infested waters.
- 5B2. Install AIS warning and information signs in infested areas.
- 5B3. Use volunteer monitors to conduct AIS inspections.
- 5B4. Develop criteria for enforcing closures of infested areas.

Protect Natives

- 5C1. Prioritize ecologically sensitive areas at risk of AIS impacts.
- 5C2. Coordinate entities to meet AIS protection and restoration objectives.
- 5C3. Develop GIS maps showing coincidence of AIS and critical ecosystems.
- 5C4. Establish guidelines for when AIS eradication or control will occur in sensitive areas.
- 5C5. Adopt guidelines on best practices for timber, agricultural or livestock activities.
- 5C6. Assess guidelines for preventing AIS spread in habitat restoration and shoreline landscaping projects.

Table 1: CAISMP Action Summary (continued)

<p>OB6: EDUCATION & OUTREACH</p> <p>Outreach</p> <p>6A1. Inventory education and outreach efforts and develop a state AIS communication strategy.</p> <p>6A2. Partner with ongoing outreach campaigns.</p> <p>6A3. Develop a DFG Communications Plan.</p> <p>6A4. Develop posters, brochures and articles for industry sectors and user groups.</p> <p>6A5. Develop permanent interpretive displays at marinas, boat ramps and fishing sites.</p> <p>6A6. Work directly with industry trade shows to deliver the AIS message.</p> <p>6A7. Present AIS information at public gatherings.</p> <p>6A8. Include AIS information in state hunting, fishing and boating regulations and licenses.</p> <p>6A9. Include AIS information in local fishing and recreational publications.</p> <p>6A10. Develop and distribute AIS identification cards.</p> <p>6A11. Encourage industries to offer noninvasive alternatives to AIS.</p> <p>6A12. Partner with stakeholders and interest groups to broaden education efforts.</p> <p>6A13. Educate waterfront and shoreline property owners about AIS.</p> <p>6A14. Develop and offer AIS management classes for professional organizations.</p> <p>6A15. Continue state education measures concerning ballast water.</p> <p>Policymakers</p> <p>6B1. Brief decision makers and legislators on AIS management progress.</p> <p>6B2. Brief the Fish and Game Commission, SLC, OPC, SCC and CCC.</p>	<p>Resource Managers & Researchers</p> <p>6C1. Increase AIS awareness among scientific and natural resource managers.</p> <p>6C2. Educate researchers on AIS containment, disposal methods and legal restrictions.</p> <p>6C3. Develop an AIS regulatory handbook.</p> <p>6C4. Share information on current mechanical, chemical, biological and physical control methods.</p> <p>6C5. Disseminate guidelines to promote use of native plants.</p> <p>6C6. Encourage the training of more taxonomists.</p> <p>Schools</p> <p>6D1. Train speakers to give guest presentations at schools.</p> <p>6D2. Assess existing K-12 environmental education curricula.</p> <p>6D3. Integrate AIS issues into service and education projects.</p> <p>6D4. Inform teachers about proper disposal methods for organisms.</p> <p>General Public</p> <p>6E1. Develop press kits.</p> <p>6E2. Increase local TV, radio and newspaper media coverage.</p> <p>6E3. Identify state publications and websites to add AIS information.</p> <p>6E4. Develop multicultural educational materials.</p> <p>6E5. Develop AIS traveling trunks and portable presentation boards.</p>	<p>OB7: RESEARCH</p> <p>Baseline Biology</p> <p>7A1. Host workshops to develop AIS research priorities and identify gaps.</p> <p>7A2. Assess, continue and complete current studies.</p> <p>7A3. Develop a strategy to communicate and support research needs.</p> <p>Economics</p> <p>7B1. Perform economic impact studies on AIS effects.</p> <p>7B2. Assess and compare costs of different management techniques.</p> <p>Management Options</p> <p>7C1. Evaluate efficacy of AIS management methods.</p> <p>7C2. Investigate the efficacy of invasion prevention techniques.</p> <p>7C3. Consider shipboard ballast water treatment testing center.</p> <p>7C4. Identify opportunities for interagency funding of AIS management research.</p> <p>OB8: LAWS & REGULATIONS</p> <p>Laws & Regulations</p> <p>8A1. Establish a regulatory review committee.</p> <p>8A2. Identify the potential for improved regulatory coordination.</p> <p>8A3. Pursue the authority to establish an interagency rapid response program.</p> <p>8A4. Explore the need for additional state authority for AIS management.</p> <p>8A5. Develop and pursue the adoption of new AIS legislation.</p> <p>8A6. Explore how new or modified regulations can bridge authority gaps.</p> <p>8A7. Develop and pursue the adoption of new regulations.</p>
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1. INTRODUCTION

What are Invasive Species?

An invasive species is “a species that is non-native to the ecosystem under consideration, and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health,” according to the National Invasive Species Management Plan (National Invasive Species Council 2001). The characteristic of causing, or potentially causing, harm is central to the federal definition because it produces policy and management consequences. In other literature and in legislation, such invaders are also sometimes referred to as “nuisance” species.

From a technical point of view, “invasive” refers to species that rapidly reproduce and spread outside their point of origin. The term “invasive species” is distinct from “non-native,” “nonindigenous,” “alien” or “exotic” species – the latter terms refer only to the origin of the species and not their rate of reproduction, dispersal or potential to cause harm (see Glossary for further definitions).

This management plan focuses on **aquatic** invasive species – algae, insects, crabs, clams, fish, plants and other invaders to California’s creeks, wetlands, rivers, bays and coastal waters. Aquatic invasive species (AIS) threaten the diversity and abundance of native species and natural communities, the ecological stability and water quality of infested waters, and the commercial, agricultural, aquacultural and recreational activities dependent on these waters. The economic consequences of AIS impacts can be substantial, from decreased productivity of commercial fisheries to lowered property values and the expenditure of billions of dollars to alleviate AIS impacts in water bodies after they have already become infested (Pimentel et al. 2000).

Geographic Scope

This report proposes AIS management actions and a rapid response plan for the State of California. The diversity of California waters is extensive and includes: the rich coastal waters and estuaries of the Pacific Ocean (approximately 3,500 miles of tidal shoreline); over 210,000 miles of rivers and streams; over two million acres of freshwater wetlands, lakes, ponds and reservoirs; over 400,000 acres of saline lakes; and more than 22,000 miles of ditches and canals (RF3 computerized database; USGS Digital Line Graph traces; SWRCB’s 2002 WBS database).

These diverse aquatic resources provide habitat for native marine and freshwater animals and plants including invertebrates, fish, and other aquatic or riparian-dependent species, aesthetic enjoyment, hydropower, irrigation, municipal and industrial water supplies and countless recreational and commercial opportunities.

The authorities and programs outlined in this plan are generally limited to the political boundaries of California; however, it is recognized that there is a need for interstate and international cooperation to prevent the introduction and spread of AIS. The plan prescribes increased coordination with all Western states, Mexico and Canada, as rivers, water delivery systems, and water-based commerce and recreation cross state or national boundaries.

History of Invasions

The introduction of non-native species into the United States has been occurring for centuries, probably beginning with the introduction of human diseases and pests as a result of European settlement. The broad scale introduction of species into California waters most clearly begins with the shipment of tens of thousands of barrels of oysters from the East Coast after the establishment of the transcontinental railway (Barrett 1963). The huge influx of settlers, the establishment of maritime commerce and a multitude of other human activities through the 1900s contributed to continued invasions.

Since then, hundreds of AIS have found their way into California waters, not only via transoceanic ships, but also by other vectors such as aquaculture, the aquarium trade, the bait industry, recreational activities, biological research, environmental restoration projects and even freshwater deliveries up and down the state. Statewide, researchers have now identified 607 introduced, or likely introduced, species in California's estuarine waters (DFG/OSPR 2002 – see Figure 1). In San Francisco Bay, the rate at which AIS are becoming established increased from an average of one new species every 55 weeks prior to 1960, to one new species every 14 weeks between 1961 and 1995 (Cohen and Carlton 1998). To date more than 250 non-native species have been found in the San Francisco Bay-Delta Estuary (Cohen, Pers. Comm. 2006).

Some of the most problematic AIS that have become established in California include the European green crab, the Chinese mitten crab, the Asian overbite clam, and a plethora of aquatic plants with origins as far away as Brazil and Japan (for full scientific references see Acronym Glossary, Species Names page 7). More information on these invasions appears in subsequent chapters. Perhaps the most important issue is not the species that have already invaded but those that might invade in the future, such as the notorious zebra mussel. Quagga mussel, which poses a threat similar to the closely related zebra mussel, was found in Lake Mead, Nevada on January 7, 2007 and subsequently in Lake Havasu in California. Based on the damage caused in the Great Lakes region by zebra and quagga mussels, these European freshwater invertebrates could threaten California's entire water delivery system, irrigation network and freshwater ecosystems.

In general, it is extremely difficult to predict the impacts that most AIS may have on natural resources, human health, infrastructure and the economy. It is clear, however, that biological invasions of California are likely to continue, as global movements of goods and services continue to increase.

In the United States, the number of non-native plant pathogens, insects, and mollusks discovered since 1920 strongly correlates with importation of goods over the same time period, and is forecast to increase by 16-24% over the next 20 years. As the world's largest economy and home to many of the world's richest ecosystems, the United States is particularly vulnerable to additional biological invasions (Lodge et al. 2006). California is equally vulnerable as a Pacific Coast trade hub, immigration and recreation destination and major engine of the American economy.

Figure 1: Nonindigenous Species Surveys from California Harbors and Bays

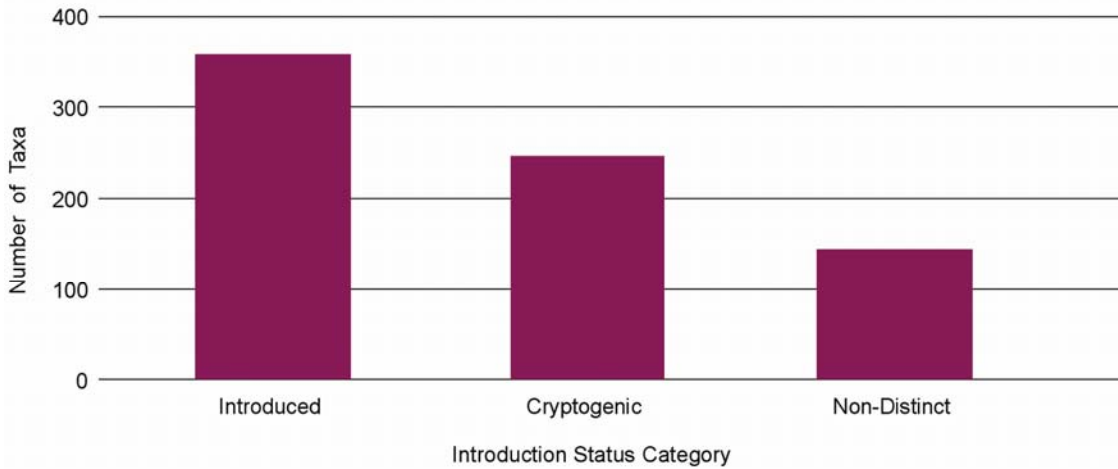
These graphs compile information from surveys that included coastal harbors, bays and estuaries along the length of the state and the Sacramento/San Joaquin Delta (up to Sacramento and Stockton). *Source: DFG-OSPR 2002*. A very small introduction status category in the source document graphs is not shown here for simplification. That category represents the number of species that may have been introduced from one region of California to another.

Outer coastal waters were not included in the surveys that generated the graphs shown here, however a new report on nonindigenous species surveys for outer coastal waters is available at www.dfg.ca.gov/ospr/organizational/scientific/exotic/MISMP.htm

Introduction Status Categories

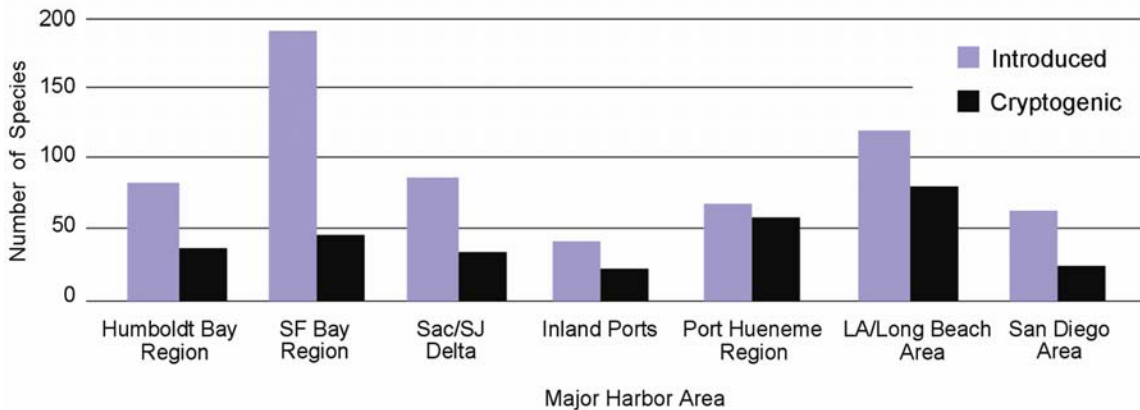
Introduced = Organisms identified to species. Introduced to California.
 Cryptogenic = Organisms identified to species. Possibly introduced to California.
 Non-Distinct = Organisms not identified to the level of species. Possibly introduced to California.

Numbers of Nonindigenous taxa by introduction status category



Number of Nonindigenous species in 7 major ports of California

This graph shows the number of introduced and cryptogenic species for each major harbor area. Species found in multiple harbor areas are represented more than once on the graph.



Benefits of a Statewide Plan

AIS pose unique challenges to California's water and resource managers, as well as to those developing policies affecting aquatic environments. Unlike other sources of pollution, established AIS populations can reproduce and spread. As a result, resources must be devoted to both the prevention of new introductions and the control of existing ones. The introduction of only a few organisms, or in the case of aquatic plants and algae, a tiny portion of an organism, can result in the infestation of an entire water body or watershed. These introductions can occur through a variety of vectors, further complicating preventative measures.

California's past efforts to address AIS focused on control of those species that most directly impacted boating, agriculture and other human activities. More recently, California's focus has shifted toward prevention, with programs aimed at excluding plant pests and managing AIS-laden ballast water on ships. Current AIS activities involve prevention, eradication, management and education. These activities are not adequately coordinated throughout the state and do not comprehensively manage current established AIS or adequately prepare for new invasions.

The vital importance of California's aquatic resources requires the creation of a more comprehensive management plan for responding to AIS. This management plan targets both marine and freshwater environments and highlights the need for aggressive action on many fronts. Although these pages describe the significant need for AIS management, there is currently no statutory mandate in California for the preparation of this management plan.

The plan meets federal requirements to develop statewide Nonindigenous Aquatic Nuisance Species Management Plans under Section 1204 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (amended as the National Invasive Species Act of 1996 – see Appendix B). This Act authorizes a 75:25 federal to state match of funds required to achieve objectives and actions outlined in plans approved by the federal Aquatic Nuisance Species Task Force (ANSTF, also established by the 1990 act). In developing this plan, the State of California has closely followed the *Guidance for State and Interstate Aquatic Nuisance Species Management Plans* developed by the ANSTF in 2000. Suggested actions contained in the Western Regional Panel's *Recommendations on State Actions to Improve Our Regional Capacity for Managing Aquatic Invasive Species* (revised June 2003) were also incorporated.

California Plan Goal & Objectives

The California Aquatic Invasive Species Management Plan (CAISMP) provides a common platform of background information from which state agencies and other entities can work together to address the problem of aquatic invasive species. Beyond providing information, the goal of this planning process has been to identify the major objectives and associated actions that need to be attained in order to minimize the harmful ecological, economic and

human health impacts of aquatic invasive species in California.

Eight major objectives have been identified:

1. Improve coordination and collaboration among the people, agencies, and activities involved with AIS.
2. Minimize and prevent the introduction and spread of AIS into and throughout the waters of California.
3. Develop and maintain programs that ensure the early detection of new AIS and the monitoring of existing AIS.
4. Establish and manage systems for rapid response and eradication.
5. Control the spread of AIS and minimize their impacts on native habitats and species.
6. Increase education and outreach efforts to ensure awareness of AIS threats and management priorities throughout California.
7. Increase research on the baseline biology of AIS, the ecological and economic impacts of invasions and control options to improve management.
8. Ensure state laws and regulations promote the prevention and management of AIS introductions.

Each objective is supported by a series of strategic actions with the implementing entities and cooperating organizations identified, and costs included where appropriate. Detailed actions can be found in Chapter 6: Management Actions, Strategies and Objectives and in Table 5: CAISMP Implementation Matrix.

The plan goal, objectives, strategies, and specific actions were developed with input from a series of stakeholder scoping meetings, interagency staff communications and public workshops held in 2002 and 2006 (see Appendix E). These meetings, as well as many individual conversations and extensive review, played a role in making the plan as comprehensive and responsive to AIS issues in California as possible.

2. AIS ECOLOGICAL & ECONOMIC IMPACTS

California currently faces a variety of significant and lasting impacts from aquatic invaders in both fresh and coastal waters. In general, these include:

- Reduced diversity and abundance of native plants and animals (due to competition, predation, parasitism, genetic dilution, introduction of pathogens, smothering and loss of habitat to invasive species).
- Degradation of wildlife habitat.
- Stresses on rare, threatened, and endangered species.
- Alteration of the native food web and declines in productivity.
- Changes in biogeochemical cycles (including nutrient cycling and energy flow).
- Losses in fisheries production.
- Impairment of recreational uses such as swimming, boating, diving and fishing.
- Impairment of agricultural infrastructure such as irrigation canals.
- Impairment of water delivery systems.
- Degradation of water quality.
- Threats to public health and safety (via parasites and disease).
- Diminished property values.
- Loss of coastal infrastructure due to fouling and boring organisms.
- Erosion and destabilization of shorelines, banks and levees.
- Increased costs to business, agriculture, landowners and government of invasive pest control, treatment and clean up.

Ecological Impacts

In terms of ecological impacts, the introduction of invasive species is thought to be second only to habitat loss in contributing to declining native biodiversity throughout the United States. Nationwide, non-native species have contributed to 68% of the fish extinctions in the past 100 years and the decline of 70% of the fish species listed under the Endangered Species Act (Wilcove et al. 1998).

California has been invaded by many aquatic plants and animals which have altered native ecosystems and taken a toll on recreation, commercial fishing and sensitive native species (i.e. species that are listed as endangered or threatened or otherwise considered rare or declining).

California Examples

- **European green crab** likely arrived in seaweed packed with bait worms shipped from the Atlantic to the Pacific Coast. They were first detected on the West Coast in San Francisco Bay in the late 1980s. By 1996 the crab had spread along 300 miles of coastal California (Lafferty and Kuris, 1996). Green crabs may prey upon juvenile Dungeness crabs as well as cultured oysters, clams and mussels (McDonald et al. 2001 & Grosholz and Ruiz, 1995). Clam and native shore crab populations in California have dropped significantly since the arrival of the green crab (Sea Grant 1998). Densities of native clams and shore crabs showed a five to ten-fold decline within three years of the green crab's arrival (Grosholz et al. 2000).
- **Arundo** is a plant native to the Mediterranean and tropical Asia. In California, it was planted as early as the late 1700s as a windbreak and for erosion control in flood channels. This reed grows in thick, bamboo-like stands that can reach a height of 30 feet. Its monotypic growth displaces native vegetation, increases flooding and siltation, increases water loss from underground aquifers and increases the susceptibility of riparian areas to fire. Despite its sizable height, it does little to shade in-stream habitat. The higher resulting water temperatures harm aquatic wildlife, including protected frogs, turtles and fish (see Appendix D, Team Arundo).
- **Asian overbite clam** was introduced into San Francisco Bay via ballast water discharge and first collected in 1986. This Asian species has since become the most abundant clam in the northern part of the bay, ultimately reaching densities of nearly 50,000 clams per square meter (Peterson 1996), and has radically altered food-web dynamics and augmented contaminant transfer up the food web (Stewart et al. 2004). It is estimated that clams in the northern portion of San Francisco Bay have the capacity to filter the entire water column at least once and possibly more than twice in a single day (Thompson 2005).
- **Wakame**, an Asian seaweed, arrived in Los Angeles Harbor in 2000 and has since spread as far north as Monterey Bay (Sanctuary Integrated Monitoring Network 2007). One plant can release millions of spores capable of remaining dormant for many years before sprouting (Fisheries Global Information System 2007). Biologists fear it will either disrupt or hybridize with native giant kelp, endangering a keystone species of the California coast (Chapman 2005).
- **Japanese eelgrass** first established itself in the Pacific Northwest in the 1950s, probably arriving as packing material for oysters. It has since colonized hundreds of acres of bays in Washington and Oregon, growing in dense mats on formerly unvegetated mudflats. Studies suggest that the eelgrass displaces native burrowing shrimp and reduces habitat quality for feeding shorebirds (Posey 1988). It was discovered in California in 2002 growing on the shores of Indian Island in Humboldt Bay.

Most of these species are not the only invader in their newfound habitats. In combination, invasive species can have even larger scale impacts on the environment. In the Sacramento-San Joaquin River Delta, for example, a clam and several plant species are all implicated in the sharp decline of endangered Delta smelt. In this small fish's habitat, the Asian overbite clam has recently increased in abundance, possibly due to seasonal changes in outflows and salinity. This invader's higher abundance and presence during more periods of the year than in the past, may be intensifying its impact on the pelagic food web which sustains Delta smelt. Young smelt, not to mention the popular sport fish, striped bass, may also be suffering from changes in habitat, water turbidity and predation levels caused by aquatic invasive weeds (Feyrer et al. in revision).

In sum, AIS may not only have direct ecological impacts on habitats, species and food webs, but can also confound efforts to restore and protect these resources. More details on specific AIS impacts and efforts to manage them can be found in the case studies in Chapters 4 and 8.

Economic Impacts: United States

Most of the environmental impacts described above have associated economic costs as managers invest time and money trying to minimize AIS impacts on native species and habitats. Other economic losses are incurred when AIS invasions hamper or jeopardize human activities. For example, in just three years in the early 20th century, the invasion of a single organism, the shipworm, caused \$615 million (1992 dollars) of structural damage to maritime facilities (Cohen, AN and JT Carlton 1995). On a national level, invasions are costing American taxpayers billions of dollars every year in environmental degradation, lost agricultural productivity, expensive prevention and eradication efforts and increased health problems. One nationwide estimate suggests that annual costs in environmental damage and losses, arising from the 50,000 invasive species now in the United States, exceed \$120 billion (Pimentel et al. 2005).

Invasives that spread into aquatic environments can be particularly costly to manage. The damage and costs associated with control of AIS in the United States are estimated to be \$9 billion annually (Pimentel 2003). A breakdown by type of invader suggests annual costs as follows:

Fish	\$5.4 billion
Zebra & quagga mussels	\$1 billion
Asiatic clams	\$1 billion
West Nile virus	\$1 billion
Aquatic plants	\$500 million
Shipworm	\$205 million
Green crab	\$100 million

In an earlier study for the U.S. Congress, the Office of Technology Assessment (OTA) attempted to quantify economic impacts of 111 species of invasive fish and 88 species of invasive mollusks. Of these only four fish species and 15 mollusk species resulted in major negative impacts—including the sea lamprey, zebra mussel, and Asian overbite clam. OTA estimated that the cumulative loss to the U.S. for the period 1906-1991 from three harmful fish species was \$467 million (1991 dollars) and \$1.3 billion from three aquatic invertebrates. Invasive aquatic and riparian plants can also have costly impacts. OTA reports that spending on aquatic plant control in the U.S. is \$100 million per year (Lovell and Stone 2005).

Another indicator of economic impacts is government spending. In 1999 and 2000, the federal government spent \$459 million and \$556 million, respectively on activities related to invasive species; however, federal funding to address fish and aquatic invertebrates was only \$20.4 million in 1999. In 2004, federal funding to the U.S. Coast Guard, largely for programs to limit invasions via ballast water on ships, was \$4.5 million (Lovell and Stone 2005). These numbers underscore how limited government spending on aquatic invasions is compared to spending on agricultural and forestry pests, despite the complexity and consequences of these invasions.

One of the most costly and well-studied North American invasions has been the introduction of zebra mussel to the Great Lakes. In 1988, zebra mussel was first discovered in Lake Saint Clair, a small water body connecting Lake Huron and Lake Erie. By 2006, zebra mussels inhabited the waters of at least 20 states. This prolific mussel colonizes pipes, constricting flow and thereby reducing water intake for heat exchangers, condensers, fire-fighting equipment and air conditioning and cooling systems. Zebra mussel densities were as high as 700,000 per square meter at one power plant in Michigan (Kovalak et al. 1993). One estimate puts the cost of scraping mussels from pipes in the Great Lakes region alone at \$50-100 million per year (Maryland Sea Grant 2003). Zebra mussels also attach to boat hulls, docks, locks, breakwaters and navigational aids, increasing maintenance costs, impeding transportation and increasing the likelihood of spread of the species.

Economic Impacts: California

AIS could threaten or undermine resources of great economic value to California. Recent statistics shed some light on the importance of California's water resources to residents and visitors alike.

- California has the largest ocean economy in the United States, ranking number one overall for both employment and gross state product. This economy (which includes coastal construction, living resources, offshore minerals, ship and boat building and repair, maritime transportation and ports, and coastal tourism and recreation) generated \$42.9 billion in 2000 and provided almost 700,000 jobs (Kildow and Colgan 2005).

- Commercial fish landed in California in 2005 had a value of over \$106 million (DFG Marine Fisheries Statistical Unit).
- Marine recreational fishing in California brought in an estimated \$768 million in expenditures in 2005 (NOAA Fisheries Service survey, formerly NMFS).
- Sport fishing licenses issued in 2005 were 1,978,143 (DFG License and Revenue Branch).
- In 2005, there were 965,892 boats registered in California. Recreational boating currently contributes \$17 billion annually to the California economy (DBW).
- California's travel industry and associated recreation contributes approximately \$55.2 billion annually to the state's economy. Much of this recreational activity is centered on water or water-based activities (California Trade and Commerce Agency, Division of Tourism).

AIS can have dramatic impacts on these important state resources and activities. Recreational boating and fishing, in particular, have long been hampered by aquatic weeds. The control of weeds to facilitate the public's enjoyment of these activities has required some of the state's longest-lived and most expensive management programs. Over the past three decades state agencies have spent more than \$60 million to keep a handful of aquatic weed species from impeding the navigation of rivers, lakes, bays and other waterways, not to mention their causing other problems for fish, wildlife, agriculture and water quality.

- **Water hyacinth** was introduced into the United States in 1884 as an ornamental plant for water gardens, where its floating showy, lavender-blue flowers attracted many admirers. Water hyacinth can double its size every ten days in hot weather. By 1904, the water hyacinth had made its way into a Yolo County, California slough. Surveys in recent years indicate that by early summer, the infestation can cover up to approximately 4,000 acres of the Sacramento-San Joaquin Delta. At present, aquatic herbicides remain the primary tools available to control water hyacinth. Two weevils and a moth have been introduced as biological controls but have not demonstrated much success. Programs to manage water hyacinth in the Sacramento-San Joaquin Delta, its tributaries and the Suisun Marsh have been the responsibility of the state's Department of Boating and Waterways (DBW). Over the program's 22-year history, DBW's costs for water hyacinth control have mounted to approximately \$25 million dollars, with annual spending currently around \$2.5 million.
- **Hydrilla** was imported into the United States from Asia in the late 1950s for aquarium aficionados. The plant, which grows in dense mats, is most likely to spread when fragments are carried into new habitat by recreational watercraft. Hydrilla has been found in 17 of California's 58 counties. Working to eradicate hydrilla – as well as managing other aquatic weeds and wetland plants such as purple loosestrife, giant salvinia, and alligatorweed – is the responsibility of the state's Department of Food and Agriculture (DFA). Since the 1970s, DFA has spent approximately \$30 million dollars on aquatic weed control, with most of that money being focused on hydrilla eradication, which costs about \$1.5 million per year. Such expenditures have enabled DFA to eradicate the plant from 19 sites in 12 counties, but much work remains to be done.

DBW and DFA expenditures on aquatic weed control are just the tip of the iceberg (see side bar). The two budgets described in the water hyacinth and *Hydrilla* programs do not take into account the cost of control efforts by other public agencies and private landowners, lost revenue due to decreased property values, impacts on fisheries or decreased use of water for swimming, boating, fishing and other recreational activities. Other costly current infestations of aquatic or riparian plants in California include saltcedar (tamarisk), purple loosestrife, perennial pepperweed, Brazilian elodea, and smooth cordgrass.

Fish, clams, crabs and other AIS can be more costly to control than plants, and in many cases, they cannot be controlled once they become established. The troublesome zebra mussel has yet to be documented in California; however, it has been detected at border inspection stations on dozens of occasions. Research suggests the zebra mussel has a broad potential range in California. Of 160 sites assessed, 44% had a high potential for colonization due to sufficient calcium level, appropriate pH, temperature, salinity range, and constant submersion (Cohen and Weinstein 1998). Most coastal watersheds, the western portion of the Sacramento Valley, the San Joaquin River and the southern Delta, offer conditions suitable for zebra mussel proliferation. Areas with a high potential for colonization encompass many of the state's most important water delivery facilities, including the Delta-Mendota Canal, the California and South Bay Aqueducts, the Los Angeles Aqueduct, the Colorado River Aqueduct, the All American Canal and their reservoirs (Cohen and Weinstein 1998).

In January 2007, quagga mussel, a close relative of zebra mussel, was found in Lake Havasu in the Colorado River in California. Quagga mussel prefers deeper, cooler water than zebra mussel but poses the same serious threat to California's entire water delivery system and irrigation network. Prevention programs for these two species would be almost identical. Until there is time to develop species specific analysis, the economic analyses and potential distribution created for zebra mussel is being used as a guideline for quagga mussel.

Damage to the water delivery system that provides drinking water to millions of southern Californians, or damage to the irrigation network that supports a \$30 billion per year agricultural industry, could produce extraordinary economic and social consequences. A recent risk analysis, based on lakes in Michigan, compared optimal spending on zebra mussel prevention to estimated costs of reducing the impacts to local power plants, if it were to become established. The analysis suggests that it would be beneficial to spend up to \$324,000 per year to obtain a modest reduction in the probability of a zebra mussel invasion into a single lake with a power plant (Leung et al. 2002).

In spite of the warnings from states already battling zebra mussels and quantitative analyses such as those described above, relatively few resources were directed towards the pending threat to California posed by these and similar organisms. Indeed the first line of defense, border protection stations, where

trailed boats arrive from infested states, were far below adequate staffing and operational hours for consistent inspection and interception, and provided little in the way of AIS information to travelers (see Management Examples, Chapter 5). After the quagga mussel was discovered in Lake Mead and the lower Colorado River, short-term emergency funding was provided to state agencies responding to the incident, and permanent funding was later authorized to provide additional staff for an ongoing program. These measures are a positive step, but additional long-term funding is needed to increase intervention at all border protection stations and provide staff to prevent further introductions.

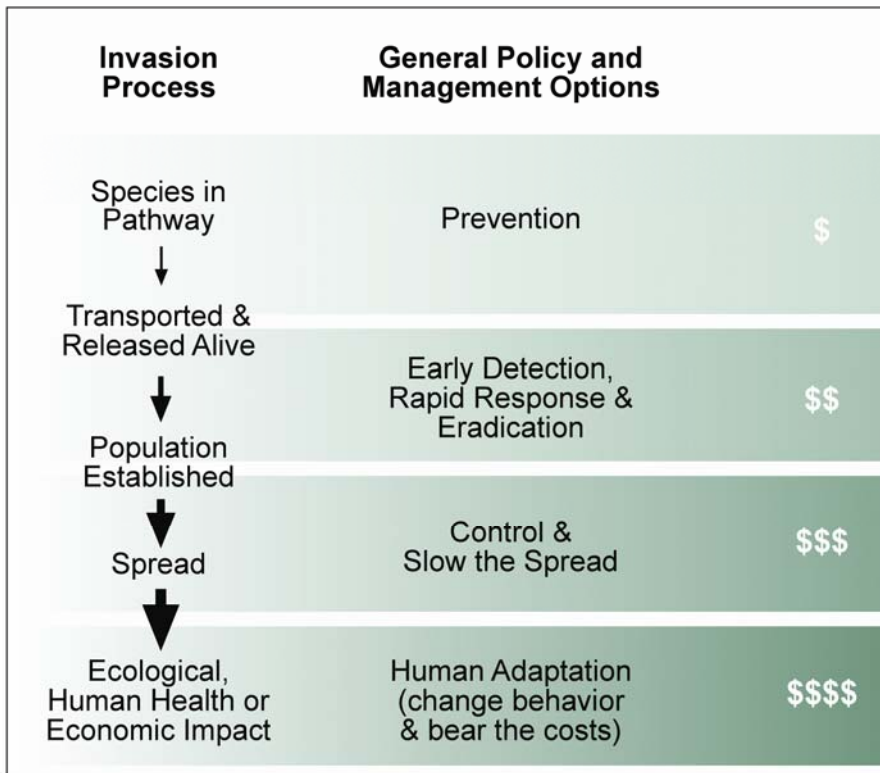
Conclusion

The harm done by invasives is a challenge to quantify. Environmental economists have been struggling to find a systematic method of quantifying human health values, use values, existence values and ecosystem values for decades. Invasive species add a level of complexity to the task that increases difficulties involved in such valuations. Rates of biological propagation, for example, do not always conform neatly with economic variables. Nor do assessments of the level of risk from invasives. Equally challenging can be attempting to quantify the benefits of preventing or controlling invasives (Lovell and Stone 2005).

Whatever the species or impacts, experts agree that the most costly response of all is inaction. Costs mount as management activities shift from prevention to rapid response to eradication to control (see Figure 2) and as invasions spread and become irreversible. While some control programs have been highly successful, many more have not even been attempted due to the perceived challenges and expense. On most management levels, the default response is adaptation – passively adjusting to the damages caused by new species – even when eradication or control would be more cost-effective. Even when the initial funding, the tools, and the political will to launch an AIS control program exists, resources must be made available in perpetuity – not an easy task in the context of government funding cycles (Lodge et al. 2006). California managers have attempted to address some of these challenges as they developed the state AIS action plan described in Chapter 6.

Figure 2: AIS Invasion Progression, Management and Cost

As AIS invasions progress, the cost of management options tends to increase. This is one of the reasons why the California Aquatic Invasive Species Management Plan places an emphasis on prevention and early detection.



Source: Adapted from Lodge et al. 2006.

3. VECTORS OF AIS

Invasive species arrive in California via vectors – the means or agents that transport species from one place to the next. Vectors, also referred to as pathways, include ships, fishing vessels, recreational boats and gear, sea planes, diving gear, drilling platforms, dry docks, and industries that grow and sell fish, plants and other organisms for food, bait, aquariums, pets and water gardens (see Table 2). Shoreline restoration or construction projects and water-based scientific research or monitoring can also inadvertently move organisms from one place to another. Invasive species cling to boat bottoms and recreational or research gear, construction equipment, floating debris and docks. They inhabit ballast water on ships, and escape or are released from aquaculture packing materials, ornamental ponds, and aquariums into the state's waters.

Once a highly invasive species arrives, preventing its rapid spread can be difficult if not impossible. Plants can produce thousands of seeds, which may be carried by wind, water, animals or human activities to distant water bodies. Some aquatic plants can reproduce vegetatively, with small bits of leaves, stems or roots resulting in new plants. Water flows and currents may also deliver these AIS to new ecosystems. Chinese mitten crabs hatch into larvae that spend one to two months drifting as plankton. During this period, the tide can carry these invaders deep into vulnerable estuary systems. Quagga mussels traveled, most likely in their larval form, on trailered recreational boats from the Great Lakes to the Colorado River system. In the past, efforts to control such invasions have focused on managing individual problem species. More recently, however, the concept of focusing on vectors, rather than species, has begun to gain support as a more effective approach for addressing aquatic invaders.

Table 2: Common Bioinvasion Vectors
Invasion Vectors and Types of Organisms Transported

Ships

- Planktonic and nektonic organisms in ballast water
- Attached and free-living fouling organisms on hull, on rudder, on propeller and propeller shaft, in seawater systems, seachests, in ballast tanks, and in ballasted cargo holds
- Organisms associated with anchors, anchor chains, and anchor chain lockers
- Organisms associated with cargo, such as logs that have been floated for loading

Drilling Platforms

- Attached and free-living fouling organisms
- Planktonic and nektonic organisms in ballast water

Dry Docks

- Attached and free-living fouling organisms
- Planktonic and nektonic organisms in ballast water

Navigation Buoys and Marina Floats

- Attached and free-living fouling organisms

Amphibious Planes, Seaplanes

- Attached and free-living fouling organisms
- Organisms in pontoon water

Canals

- Movement of species through sea level, lock, or irrigation canals

Public Aquaria

- Accidental or intentional release of organisms on display
- Accidental or intentional release of organisms accidentally transported with target display species

Research

- Movement and release of invertebrates, fish, seaweeds (algae) and seagrasses used in research (intentional or accidental escape)
- Organisms associated with research and sampling equipment, including SCUBA and other diving or swimming gear

Floating Marine Debris

- Transport of species on human-generated debris, such as floating nets and plastic detritus

Recreational Equipment

- Movement of small recreational craft, snorkeling and SCUBA gear, fins, wetsuits, jet skis, and similar materials

Fisheries, Including Marine Aquaculture (Mariculture)

- Transplantation or holding of shellfish, such as oysters, mussels, clams, crabs, lobsters, and other organisms; fish; or seaweed (algae) in the open sea for growth or freshening (rejuvenation); and other organisms associated with dunnage and containers
- Intentional release of shellfish, fish, and seaweed (algae) species, either as part of an official governmental introduction attempt, or as an illegal private release
- Stock enhancement, often ongoing, as well as accidentally transported associated organisms
- Movement of live seafood intended for sale but then released into the wild
- Processing of fresh or frozen seafood and subsequent discharge of waste materials to environment, which may include associated living or encysted organisms
- Movement of live bait subsequently released into the wild
- Discarding of packing materials—such as seaweed and associated organisms—used with live bait and seafood
- Movement, relocation, or drifting of fisheries gear, such as nets, floats, traps, trawls, and dredges
- Release of organisms as forage food for other species
- Organisms transported intentionally or accidentally in “live well” water, vessel scuppers, or other deck basins
- Release of transgenic stocks—genetically modified organisms (GMOs)
- Movement of algae and associated organisms as substrate for fish egg deposition

Aquarium Pet Industry

- Movement and release of invertebrates, fish, seaweeds (algae) and seagrasses used in the aquarium industry (intentional or accidental escape)

Restoration

- Movement of marsh, dune, or seagrasses as well as associated organisms
- Reestablishment of locally extinct or decimated populations of native species, and accidentally transported associated organisms

Education

- Release of species from schools, colleges, and universities following classroom use

Source: Carlton 2001

Analyzing the risk of specific AIS vectors to the environment, human health and the economy represents a critical first step in preventing invasions. Many factors contribute to the invasion risk posed by a given vector. These include:

- number of nonindigenous species transported;
- number of individuals of each species transported;
- characteristics of the species (including their environmental tolerances);
- number and characteristics of their hitchhiking species (including parasites, pathogens and other associated organisms);
- likelihood and frequency of a species and its hitchhikers reaching suitable habitat;
- feasibility and cost of eradication or control if a species becomes invasive (Lodge et al. 2006).

Any quantitative analysis of invasion risks will not only examine these factors, but also seek the point source of invasions and evaluate opportunities for management of each vector.

Large vectors, such as commercial shipping, are not the only source of large-scale invasions. Seemingly minor vectors can lead to major invasions. For example, the use of seaweed to pack bait worms from the U.S. Atlantic Coast brought the European green crab to the Pacific Coast (Carlton 2001). Preventing introductions from smaller vectors can therefore provide significant ecological and economic benefits.

The live trade, including the pet, aquaculture and horticulture industries, introduces far fewer exotic species than ships and other transportation vectors; however, prevention efforts aimed at this sector are well worth their cost. Providing education and oversight to these purveyors tends to cost less than comparable efforts aimed at transportation vectors and can preclude the far larger costs of stopping an invasion. The burgeoning mail order/Internet trade has only increased the risk from these pathways. Meanwhile, the water garden and live food industries are growing rapidly and will likely become the source of more invasions in the future. These trades frequently put non-native species of plants and animals in close proximity to natural waterways where they are more likely to find conditions suitable for establishment (Lodge et al. 2006).

Raising awareness of the invasion risks from ballast water discharge and hull fouling, as well as among aquarium, pet, nursery, aquaculture and seafood industry groups, has great potential to change public behavior and develop cooperative guidelines for industry practices. In the end, these measures may significantly reduce the likelihood of AIS introductions (Lodge et al. 2006).

California's initial focus may have to be on vectors currently thought to pose the highest risk of invasion. The ultimate goal, however, is to assess all potential vectors and to manage those that present the highest risk of new

invasions. The sections that follow seek to provide general information on some of the diverse vectors by which AIS enter California. Details on the regulation control and management of these vectors appears in subsequent chapters. The general vector categories described below are:

- Vector 1: Commercial Shipping
- Vector 2: Commercial Fishing
- Vector 3: Recreational Equipment & Activities
- Vector 4: Trade in Live Organisms
- Vector 5: Construction in Aquatic Environments
- Vector 6: Water Delivery & Diversion Systems

Vector 1. Commercial Shipping

In coastal environments, commercial shipping is the most important vector for the introduction of AIS (Ruiz et al. 2000, Hewitt et al. 2004). In one study, commercial shipping accounted for one half to three-quarters of nonindigenous introductions to North America (Fofonoff et al. 2003). The steady rise of global commerce, increased shipping activities and shorter transport times suggests that the threat of introductions through this vector is increasing.

California, as a coastal state engaged in significant Pacific Rim trade, cruise-line tourism and commercial fishing, is vulnerable to the global rise in invasions. California hosts 11 major seaports: Hueneme, Humboldt Bay, Long Beach, Los Angeles, Oakland, Redwood City, Richmond, Sacramento, San Diego, San Francisco and Stockton. Three of these ports are among the top four busiest ports in the United States. Two of these ports are located a significant distance inland and are slated for expansion, potentially importing more AIS deeper into the state. These 11 seaports handled 23% of the United State's waterborne trade in 2003. Almost 95% of containerized Asian cargo destined for central and mountain states entered through West Coast ports – highlighting California as a first national line of defense against AIS (PMSA 2004).

Ballast Water

Shipping vessels commonly fill their ballast tanks with water from harbors after unloading cargo and discharge it in another harbor when loading more goods. The added mass of ballast water improves stability, trim, maneuverability and propulsion in large, otherwise empty cargo vessels. Vessels may take on, discharge, or redistribute ballast water during cargo loading and unloading, in rough seas, or while moving through shallow waterways. Live marine organisms ranging from plankton to adult fish are regularly transported from source to destination ports when ballast water is discharged (Carlton and Geller 1993, Cohen and Carlton 1995). Estimates suggest that more than 7,000 species are moved around the world daily in ballast water alone (Carlton 2001).

Ballast water teeming with a wide array of non-native organisms is discharged into U. S. waters at the rate of about two million gallons per hour. In 2005, 9.1 million metric tons were reported to have been discharged in state

waters (Falkner et al. 2006). California requires vessels arriving from outside the United States Exclusive Economic Zone (U.S. EEZ), or engaged in coastal travel, to manage their ballast water. Federal regulations (USCG) also require ballast water management. See Chapters 4 and 5, and Appendices B and C for more information on state and federal regulations and programs. Actions in this AIS management plan recognize and support these ballast water management activities.

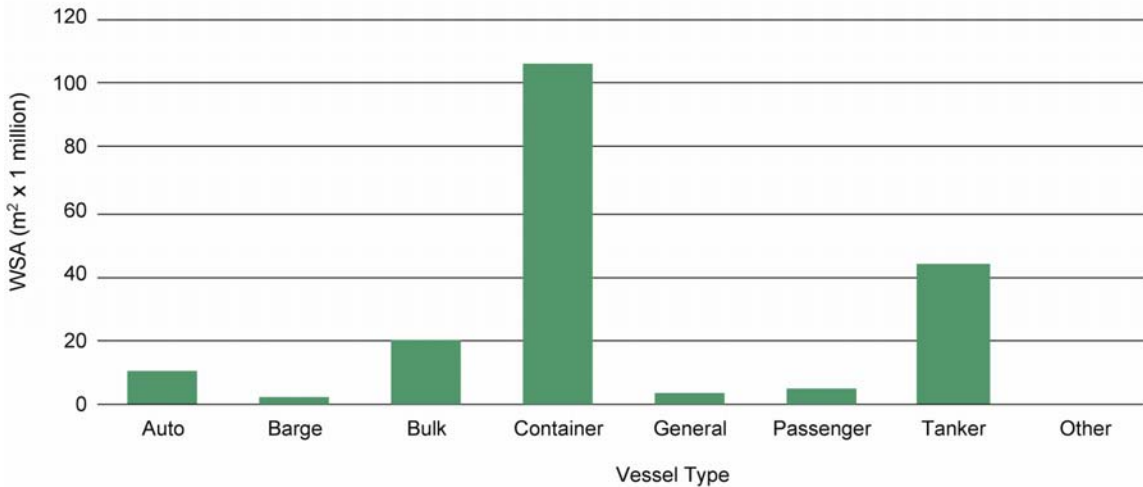
Hull Fouling

Hull fouling may rival ballast water discharge as the leading cause of harmful AIS introductions (Thresher 1999, Hewitt 2002). Organisms such as mussels, seaweed, anemones and sea squirts with sedentary life stages can attach themselves to the hulls of commercial vessels or become entangled in nets, anchors, and other gear. Barnacles, other seaweeds and bryozoans may in turn attach to mussel shells and seaweed fronds, while more mobile species such as shrimps, worms and sea snails may hide in crannies created by larger fouling species (Takata et al. 2006). These organisms can survive for extended periods of time once secured to a vessel. Fouling organisms may then be transferred from the vessel to coastal waters and ports via spawning or egg release, detachment (simply dropping off into the water) or mechanical removal (via scraping, in-the-water cleaning or blasting in dry dock depending on clean up procedures).

Fouling organisms live on wet surface areas such as vessel hulls. One study analyzed the total "wetted surface area" (WSA) of all vessel hulls arriving on the West Coast between July 2003-June 2005 (Takata et al. 2006 – See Figure 3). The goal was to provide some indication of the rate and pattern with which individual organisms may arrive (propagule pressure), and how they may contribute to AIS establishment. The resulting two-year total of WSA entering California waters was 189.5 million square meters, which is 1.5 times the area of San Francisco County.

Figure 3: Wetted Surface Area

Total wetted surface area (WSA) is the estimated total of submerged surface area for each type of commercial vessel shown on this graph, that arrived in California ports between July 2003 and June 2005. Wetted surface area represents potential for fouling accumulation. The potential magnitude of the threat from hull fouling is significant, however, without reliable data on the extent of fouling found on commercial vessels, the ability to determine this risk is limited.



Data courtesy of Ian Davidson, Aquatic Bioinvasion Research and Policy Institute.

Source: Takata et al. 2006

In an expansion of California's ballast water management program, recent legislation directed a team of technical advisors to formulate recommendations to prevent introductions through vessel fouling, among other non-ballast shipping vectors. The team's report documents several factors concerning this vector. For example, the degree of fouling may be affected by environmental conditions, vessel maintenance practices, types of shipping traffic and vessel movement patterns, all factors which may differ from region to region. (Takata et al. 2006). See Chapter 4 and Appendix C.

Vector 2. Commercial Fishing

While commercial fishing vessels do not usually carry ballast water, they can be an important AIS vector. As these vessels sit in harbors, docks, and berths during the off-season for long periods, they are more subject to the hull fouling described under Vector 1 than commercial ships (which travel so constantly through waters of widely varying temperature and salinity that their hulls remain relatively clean). Commercial fishing vessels can also carry AIS from one harbor to another via their fishing gear, lines, tackle, buoys, traps and nets. Researchers believe the Japanese marine algae, wakame, may have been introduced to Monterey Bay by fishing vessels from other California ports. Though the state currently regulates ballast water and may soon regulate hull-fouling, it has no authority over vessels under 300 gross register tons in size, such as commercial fishing vessels. More information is needed on the AIS risk from this vector. Actions in this management plan seek to address this need.

Vector 3. Recreational Equipment & Activities

Boating & Sea Planes

The lakes, ponds, rivers and coastal waters of California provide recreational opportunities for a large population of boaters. The movement of boats along the coast, as well as the overland transport of boats and their trailers between water bodies, can introduce AIS that foul hulls, become entangled on motor propellers, and are small enough to be discharged in bilge pump water. In addition, aquatic invasive plants and other AIS can also be transported from one body of water to another through entanglement on aircraft pontoons. Recreational boats and sea planes can be both the source of an initial introduction (bringing in a species from its native location, into California), or a source of spread of a species once it arrives via other vectors such as ballast water or aquarium releases. This is the case with zebra mussel and quagga mussel, which were thought to have originally entered the US via ballast water, and now have spread throughout many areas in the United States via recreational boats.

Fishing

Recreational fishing is another vector in the introduction and spread of AIS. Initial introductions can occur when bait buckets and live tank contents are dumped. Gear used for fishing (boats, nets, floats, anchors, wading boots, tackle, etc.) can spread AIS. For example, fly fishing gear used in waters infested with New Zealand mudsnails, may be the primary vector associated with the spread of this AIS into California's rivers.

Other Water Sports

Those engaged in California's diverse variety of other water sports – swimming, jet-skiing, windsurfing, parasailing, scuba diving, waterfowl hunting – can all also be potential carriers of hitchhiking AIS as sports gear is moved among coastal and inland recreational spots.

For all recreational water users, clear identification of AIS-infested waters through posted signs and by other means would reduce the risk of the transport of established invaders. This measure, along with vessel inspections and investigating the feasibility of installing washing stations for recreational watercraft, are actions in the management plan. Education of all recreational users – and for non-aquatic equestrians, hikers and cyclists crossing streams and rivers – is also recommended in this management plan.

Vector 4. Trade in Live Organisms

Live Bait Industry

The shipment of live, non-native fishes or invertebrates into California for use as bait may serve as another vector of AIS introduction. Packing materials are frequently comprised of live plants that have the potential to become invasive. Knotted wrack, a seaweed native to the North Atlantic, is the primary packing material for marine baitworms (blood worms and pile worms) and American lobsters shipped to California. This seaweed often harbors a substantial number and variety of non-native marine organisms. Of further concern is live bait that harbors parasites or pathogens that could endanger the health of human populations or native species. The state regulates the culture, import, harvest and sale of fish species sold as bait; however, the sources of invertebrate imports to California for recreational fishing purposes are largely unknown and unregulated. Actions in the plan address the need to evaluate, improve and enforce regulations designed to minimize the invasion threats from both live and frozen bait. Frozen bait has recently gained more attention as a potential vector for AIS because the virus that causes hemorrhagic septicemia, a disease that causes fish to bleed to death, has been found to survive in frozen bait (Bergquist 2007).

Live Imported Seafood

The import, sale and distribution of fresh, live seafood are important component of California's economy. The processing and sale of live fin and shellfish can result in the intentional or unintentional release of live organisms as well as their associated parasites and pathogens. Specific seafood-related introduction pathways include packing materials, as discussed in the prior section, and the following:

Shellfish waste disposal: Shells and other unwanted materials discarded following shellfish processing might harbor shellfish pathogens or live epiphytes (plants that grow on organisms or objects, rather than on the ground), as well as embryos or other developing stages of the shellfish species. Disposal of this material in or near a water body could result in unwanted introductions, as well as other types of water quality impairment.

Bivalve wet storage: Holding shellfish in flow-through systems subjects surrounding surface waters to pathogens and other organisms that may be discharged during tank flushing. Transporting shellfish in nests of algae or other plants also poses the risk of introductions when these packing materials are discarded.

Creation of new fisheries: Several aquatic invaders, such as the Chinese mitten crab, may have been released intentionally in hopes of founding a new and commercially valuable fishery (Whitlatch et al. 1995). Seafood suppliers and commercial and recreational fishers and anglers, who are unaware of the detrimental impacts resulting from these introductions,

may be tempted to release these species into local aquatic systems to establish a self-sustaining population that can be harvested for consumption.

Aquaculture

California has the most diverse aquaculture industry in the United States. Like the seafood industry, aquaculture is an important sector of the California economy and has the potential for significant growth as more limits are imposed on wild fish harvests. While intensive culture of both finfish and shellfish reduces the harvesting pressure on wild stocks, concerns related to water quality impairment, the growth and distribution of pathogens, the escape of non-native species, and genetic dilution indicate a need for careful planning in this industry. The following are examples of how non-native species introductions can occur through intensive aquaculture operations.

Shellfish seed import: Shellfish seed is commonly grown in hatcheries and imported to California for use in commercial operations such as oyster culture. While the state regulates the sources of seed for this industry, there is the potential for the import of shellfish pathogens and other organisms associated with shellfish, such as boring organisms, from outside of the state. An enhanced capacity to identify and manage shellfish diseases will be necessary to minimize the loss of shellfish due to these threats.

Abalone culture: Farmed commercial abalone is a small but productive industry that recently felt the sting of an introduced parasite. The industry's struggles with the South African sabellid worm offer a good example of what can happen when shellfish are transferred among hatcheries across state and national boundaries (see also Management Examples, Chapter 4). Although both abalone aquaculture and stock importations are regulated by the state, new guidelines for the movement of live organisms may be needed.

Shellfish waste: Several shellfish species cultured in California prefer clean, hard surfaces on which to settle and attach. Placement of shellfish waste as substrate in grow-out areas has raised concern over the source and proper disinfection of this waste material and the potential of this practice to transport shellfish pathogens or other associated non-native species.

Finfish culture: Raising finfish in open systems such as raceways, flow-through tanks and net pens exposes surrounding aquatic systems to pathogens commonly associated with cultured fish populations, and introduces the possibility of escape of the aquaculture species into adjacent waters. The state regulates this industry and requires that species cultured in watersheds where they are not already present be isolated from natural systems.

Genetic dilution: Strains of shellfish and finfish used in aquaculture are often imported or represent stocks that have been genetically altered or selected for particular traits such as large size or disease resistance. Cultured stocks are usually at a disadvantage in competition with wild populations in the natural environment; however, farmed Atlantic salmon have been documented to escape and survive in the wild in Pacific Coast waters.

California has addressed many of these concerns through existing laws and regulations; however, several actions related to the prevention of introductions through the shellfish and aquaculture industries have been included in the plan.

Recreational Fisheries Enhancement

It is common practice in the United States for federal and state agencies to import game fish to enhance recreational fishing. Private citizens have also illegally transported and released fish species into waterways in hopes that a viable population would survive. Non-native fish introductions in California peaked in the 1960s, when 13 new species were introduced (Moyle 2002). Illegal fish introductions, including species newly brought to the state and transfers of already-established species to new sites are of increasing concern in California. There are 51 non-native freshwater fishes currently found in California; the majority introduced deliberately, whether legally or illegally, in an attempt to enhance recreational fisheries (Moyle 2002). Non-native fish are now the most abundant fish in many waterways in California, raising concerns about increased competition, predation, habitat interference, disease and hybridization with native species.

Aquarium & Aquascaping (Water Gardens)

Non-native marine and freshwater organisms can be introduced accidentally or purposefully after being imported for use in aquaria and water gardens (Carlton 2001). Aquatic plants available through these industries are often native to temperate regions and are selected for their ability to thrive under adverse environmental conditions. Of additional concern is the mislabeling of imported organisms, particularly aquatic plants, which may then be confused with native or innocuous species and released by the consumer. Careful inspection of stock shipped and received is important; aquatic plants such as water lilies have reportedly been shipped from nurseries still entangled in fragments of invasive hydrilla plants.

Live rock – coral skeleton that has been colonized by marine plants, microorganisms, and algae – poses a similar threat as a means of invasive species transport. Imported from tropical reefs, live rock is becoming a favored means to decorate and improve water quality in aquaria. Live rock is currently not subject to quarantine or other biological regulations, and has the potential to

transport small invasive species ranging from algae to jellyfish (Bolton and Graham 2006).

The state monitors and regulates a limited number of aquarium and aquascaping species. Enforcement can be difficult, as California's nursery industry includes approximately 3,500 growers, 3,000 retail nurseries and 3,500 incidental dealers such as supermarkets, drugstores and other chain-store markets. Many species of concern, particularly freshwater aquatic plants, are also now readily available via the Internet and through mail order catalogs for water gardening. Some of the most popular AIS still commonly sold include water hyacinth, parrot feather milfoil, Brazilian elodea, water lettuce, yellow floating heart, paleyellow iris and European frogbit.

Widespread use of the Internet for commercial sales of non-native aquatic plants and animals is particularly troubling. Federal agencies have the authority to regulate sales of invasive plants and invertebrates through the aquarium and water garden trades; however, California's capacity to monitor and regulate the importation of species is limited to those restricted by statute. The state can play a more active role by encouraging providers to monitor their shipments and by providing recommendations for care and handling. Efforts can be made to provide information to Internet suppliers based in California about the risks of particular species. Educated consumers can provide an added level of security by carefully inspecting shipments, after they are received and prior to release, to make sure they are not contaminated by additional AIS.

For all types of AIS imports – whether into stores, through catalogs or via the Internet – more education and outreach, inspections and enforcement are needed at both the state and federal level. Such steps are among the actions recommended in this management plan.

Research & Educational Activities

Marine and freshwater species can be ordered from research and education supply companies around the world through catalogs or Internet websites. While these organisms are generally supplied for research purposes, many companies also sell species for use in home aquaria. Few suppliers of live organisms, among them marine labs and research facilities, provide guidelines documenting use and handling practices.

Once the organisms are delivered, improper handling techniques may result in the release of non-native species. Both lab and field practices routinely present the opportunity for AIS release through wastewater discharge, disposal of unwanted organisms, poorly contained studies, etc. The invasion of the colonial sea squirt, *Botrylloides diegensis*, in Massachusetts is believed to have occurred via this vector (Whitlatch et al. 1995).

Vector 5. Construction in Aquatic Environments

Many types of construction are conducted in aquatic environments, including the maintenance of canals and water delivery systems, the creation of shoreline parks and developments, the dredging of shipping channels and marinas, the control of riparian and levee-bank erosion, and the restoration of wetland, riparian and shallow water ecosystems. All of these activities, and the equipment used to accomplish them, can transfer or introduce AIS.

Construction Equipment: The use of contaminated construction equipment and the transport of sands and sediments during marine construction (building and installation of docks, platforms, bulkheads, breakwaters, artificial reefs, etc.) can lead to the introduction of unwanted AIS. Similarly, the use of heavy machinery, such as harvesters and dredges, to remove AIS and/or sediments from infested water bodies, can spread AIS from one site to another if the equipment is not properly cleaned between projects.

Canals, Channels, and Aqueducts: The building of canals, channels and aqueducts creates artificial connections between waterways, allowing the free movement of species across physical barriers. Increasingly in California, fish are being introduced into new areas by aqueducts that bridge drainages (see below).

Ecosystem Restoration and Erosion Control: Historical examples abound of non-native plants being introduced to California for habitat restoration and/or erosion control with disastrous results, including species of cordgrass, tamarisk and *Arundo*, to name a few. Awareness of this problem needs to be increased and alternative plant choices must be made available and encouraged or required. Equipment used during habitat restoration and subsequent monitoring should be cleaned to avoid transferring AIS from one site to another.

Vector 6. Water Delivery & Diversion System

The state's extensive water delivery, export, transfer and development system, which moves water not only from one watershed to another, but also from one end of the state to another, and even across state lines, can be an important vector of AIS. Water deliveries can spread freshwater-adapted AIS within and out-of-state, and carry species from infested areas to more pristine locales. For example, the yellowfin goby was first found in the San Francisco Estuary, and then in the Delta-Mendota Canal, a feature of the Central Valley Project. The yellowfin goby was later found further south, in the California Aqueduct, which is part of the State Water Project and transports water from northern and central California to the Los Angeles area. More recently, the yellowfin goby has been found in the San Luis Reservoir in the western San Joaquin Valley. The California Aqueduct has transported a number of species, both native and invasive. Scientists have already identified species they predict will travel to new locales on this waterway, such as the Shimofuri goby found in

the Suisun Marsh northeast of San Francisco, and more recently in Pyramid Reservoir, 39 miles from downtown Los Angeles.

A significant amount of water, and whatever AIS are in it, is moved around California each year to supply drinking, irrigation and other water supplies for human activities. The state's two largest water distribution systems, the State Water Project and the federal Central Valley Project, can move up to four and seven million-acre feet of water each year, respectively. At least 7,000 other users also have permits to divert water. During the period 1998 and 2001, approximately 30-37 million acre feet of water were diverted from their original courses annually in California. Of these transfers, between 3.9 and 4 million acre feet of water transfers came from the Colorado River (Messer 2007).

The likelihood of spreading aquatic invaders via water diversion is not proportional to the amount of water that is being transferred. Often, water is moved to a water treatment plant where it will be processed into safe drinking water or to agricultural fields inhospitable to aquatic species. Water turbines may be fatal to invasive species. When an invasive species arrives in a new location, it does not always establish. For instance, Chinese mitten crabs transported to an agricultural canal near Bakersfield, California by the Central Valley Project cannot establish a viable population because they need access to an estuary to complete their life cycle.

Water managers are working to better track AIS in their equipment and systems. State and federal project managers, for example, monitor AIS by counting mitten crabs which clog the fish screens at fish collection facilities in Tracy, California, where water is diverted from the Delta. Native and non-native fish are counted, collected, and salvaged, and new fish species have been noted at these facilities. Less extensive sampling, mostly to determine fish loss, is conducted at other regional water diversion facilities.

Intensive manipulation of natural water paths and flow rates, and other characteristics of the state's aquatic and adjacent ecosystems, make California particularly vulnerable to AIS. Not only can AIS be more easily transferred via these diversions but they can also find it easier to colonize areas where native species are already stressed by dams, water diversion, altered hydrology and development in their habitats.

Conclusion

The above is only a discussion of the primary vectors of aquatic species invasions. In the past 200 years, the number of vectors available to transport marine species has steadily increased. In the year 1800, ships and the materials carried for ballast were the major mechanisms of introduction. By 2000, there were at least 16 known human-related vectors (Carlton 2001). The increasing diversity of vectors makes the prevention of introductions an even greater challenge.

4. MANAGEMENT FRAMEWORK

Efforts to manage aquatic invasive species began more than a century ago when water hyacinth and alligatorweed began to clog navigable waterways. Early 1900s management efforts involved chemicals that generally proved either ineffective or poisonous to livestock and wildlife and mechanical removal, either by hand with a scythe or with the help of "crusher boats," which smashed floating vegetation between heavy rollers, and "saw boats" which shredded plants with rotating blades (Hoyer and Canfield 1997). Since then, management approaches have changed and become more diverse to include everything from hyperspectral remote sensing, ozone treatment and K-12 education curricula to herbicides, electro-fishing, Internet sales precautions, PowerPoint presentations and border inspections. Numerous international, federal and state laws have been passed aimed at preventing and controlling invasions, and numerous government agencies, NGOs, industry groups and other organizations have become involved in AIS management.

Most long-established programs – both state and federal – are targeted at managing terrestrial agricultural pests, which can spread easily by wind, fog and through the air. Many of these programs are species specific. Efforts to manage invaders living in and around water present a different set of challenges for containment and control and focus on preventing vectors from bringing in new species and on developing early detection networks. This chapter:

- explains the generally accepted management framework and control options for AIS;
- provides a brief overview of AIS programs operating in California;
- summarizes the responsibilities of California state agencies most involved in AIS work;
- lists gaps and challenges in state AIS management.

A summary of AIS-related state and federal laws and authorities can be found in Chapter 5, with a more comprehensive description and more extensive agency information appearing in Appendices B, C and D. A list of regulated AIS species can be found in Appendix G.

General Framework

On a general level, invasive species management involves five basic strategies, often in combination:

- Prevention
- Early Detection & Monitoring
- Rapid Response & Eradication
- Long-Term Control & Management
- Education & Outreach

This basic framework, well established on a national level, is also reflected in California's existing pest prevention programs and weeds management plans. It forms the foundation of management actions described in Chapter 6 of this plan.

In choosing management approaches within this framework, the nature of the invader itself comes into play (see Table 3). Some invaders (such as the zebra mussel) may be known troublemakers in other states or nations but have not yet arrived in California, suggesting a management response focused on monitoring, education and early detection. Other invaders (such as the water hyacinth choking boating channels and lakes) may be so well-established that eradication is infeasible and ongoing chemical and/or mechanical removal is selected to minimize the harmful effects of the infestations. Still others (such as the Asian overbite clam colonizing the floor of Suisun Bay) may present no management option whatsoever since there is no environmentally acceptable way to treat or remove widespread benthic invertebrates in open waters. Whatever the species, the possible human management responses generally narrow as any invasion progresses (Lodge et al. 2006).

Table 3: Species Management Types

SPECIES MANAGEMENT TYPE	REPRESENTATIVE SPECIES	MANAGEMENT RESPONSE
Type 1 Not yet detected in California or eradicated	<i>Caulerpa</i> Northern Pacific seastar South African sabellid polychaete snakehead zebra mussel	Monitoring Early detection
Type 2 Limited in extent	Hydrilla channeled apple snail <i>Salvinia</i> smooth cordgrass quagga mussel	Early detection Rapid response Eradication
Type 3 Established but manageable	African clawed frog <i>Egeria</i> Chinese mitten crab Eurasian watermilfoil European green crab purple loosestrife salt cedar water hyacinth	Localized eradication Impact mitigation Control of spread to other water bodies Research on control technologies
Type 4 Widespread but currently no large-scale control options	Asian overbite clam inland silverside New Zealand mudsnail bullfrog water lettuce pale yellow iris	Monitoring Prevent spread to new water bodies Research
Type 5 Unknown invasion potential	Asian swamp eel green sunfish salt meadowcordgrass	Research and evaluation

The Species Management Type (SMT) characterizes the distribution and degree of establishment of an AIS in California and could be assigned to any AIS species. This characteristic is useful to consider when setting management priorities or planning for a management response to a potential or actual AIS infestation. Representative species are merely examples, as this table is not meant to provide a comprehensive list of species sorted by SMT. Though valid at the time of publication, the status of the species mentioned is likely to change over time. For more examples see Chapter 8.

Prevention

Preventing AIS introductions is the single most cost-effective and environmentally beneficial management approach and is the first line of defense. This approach focuses on preventing the release of AIS into state waters via ballast water, fouled hulls, marine equipment movements, aquatic recreation and research activities, and by the producers and buyers of bait, aquariums, seafood and other live organisms. Pest prevention programs for noxious weeds often refer to this type of prevention as “exclusion” (keeping the species out of the state). Many prevention programs focus on minimizing the introduction of all species into the environment via specific vectors. This is because it is very difficult to predict which species will invade and cause significant impacts. It is also very difficult to identify the actual species of potential aquatic invaders (especially very small invertebrates, internal parasites, and unicellular organisms). Inspection programs, such as those for smaller boats and retail and wholesale businesses, are also part of prevention, but generally target specific species rather than the entire range of species that those vectors could potentially introduce.

Prevention programs may include everything from inspections of stores, industries or facilities that may be harboring or selling AIS to education and outreach. As prevention is the least expensive and most effective management response, every vector deserves state level consideration and coordination.

Monitoring, Early Detection & Rapid Response

Some species will evade prevention programs. A few of these will spread, after a certain lag time and become pests. The lag time between establishment and spread, which could be weeks to years, offers an opportunity for detection and eradication. Taking action while populations are small and localized is extremely important but the effort required to detect a species can be inversely proportional to its population size. Sound management must balance the high costs of surveys aimed at detecting small populations over a wide area against the high costs of eradication if a survey fails to catch an invasion early on. New surveillance technologies and web-based reporting and information networks may help increase the success of early detection efforts (Lodge et al. 2006). Enlisting the help of citizen monitors, watershed groups, professional diving associations, and others often in and out on the water may also prove effective.

Once detected, rapid response often involves an attempt to eradicate the invader by chemical, mechanical or other means. This works best when the invader appears in an isolated lake, creek or other water body where spread can be contained and the environmental impacts of chemicals used to kill the invader is minimized. Eradication may be possible in isolated areas of one part of the state while larger scale control programs may be necessary in others where infestations have spread. For this reason, it is sometimes hard to categorize existing response programs as either “eradication” or “control.” Such measures often go hand-in-hand on a statewide scale.

MANAGEMENT EXAMPLES: BALLAST WATER & HULL FOULING

California law began mandating ballast water management for ships arriving from foreign ports in 1999. During the ballast exchange process for vessels entering the state from outside the U.S. Exclusive Economic Zone (U.S. EEZ), biologically rich water loaded at the last port of call is flushed out of ballast tanks and replaced with the water from the open ocean, beyond 200 nautical miles (nm) from land. For vessels moving along the coast, the exchange is done outside of 50 nm. Organisms are generally less numerous in the open ocean and it is expected that they will be poorly adapted to survive once discharged in the very different environmental conditions of a near shore port. Scientific research indicates that offshore ballast exchange typically eliminates 70% - 95% of the organisms originally taken into a tank while at or near port (Zhang and Dickman 1999, Parsons 1998). Other studies suggest that exchange efficiency is inconsistent and ranges from 50-90% (U.S. Coast Guard 2001). Most experts view ballast water exchange as a short-term solution, with the final resolution being a combination of ship-board treatment technologies and management options such as ballast water retention or the use of freshwater as ballast, among others (Falkner et al. 2006).

Minimizing the release of invasive organisms growing on or clinging to the hulls of oceangoing ships and commercial fishing vessels is also an important frontier of AIS management. Commercial vessel operators have long endeavored to keep fouling to a minimum on their ships for other reasons. Fouling creates drag, increasing fuel consumption, and/or straining the engine; it can also block pipes bringing in seawater to cool machinery. To prevent such problems, commercial vessels periodically clean their hulls and utilize antifouling coatings designed to discourage the attachment of organisms. While these measures do reduce the amount of fouling on a ship, consequently reducing the potential for AIS to be moved to new locations, they can create water quality problems. Most antifouling coatings slowly release toxic substances. Vigorous scraping of a hull while a vessel remains in the water can exacerbate the quantity of toxins and toxic debris released into surrounding waters. Biocide-free anti-fouling alternatives are currently being researched (Anderson). Recommendations for a new state program targeted at reducing the risk of AIS release from hull fouling (including consideration of some of the water quality concerns) were completed in 2006 (Takata et al. 2006). For more information on current California ballast water and hull fouling management programs see SLC section later in this chapter.

In order to effectively respond to the early detection of an AIS occurrence, several states have developed formal interagency rapid response plans. California has recently begun this process and written a draft rapid response plan (Appendix A). The goal of such plans is for agencies and other interests to work together as effectively and efficiently as possible through prior agreements about: roles and responsibilities, chains of command and communications, criteria for initiating rapid response actions, public safety, funding, regulatory permit processes, public information, data collection, implementation and follow-up evaluation. In other words, a rapid response plan lays out how federal, state and local officials should respond if an AIS of particular concern (such as the zebra mussel, see below, or the marine algae *Caulerpa*, see Chapter 8) is detected. Response can be delayed by permitting processes developed for maximum public input and thorough review, rather than for emergency response timelines. Both federal and California agencies have recognized the need for special levels of coordination and cooperation to facilitate rapid response.

MANAGEMENT EXAMPLES: ERADICATION OF SABELLID WORMS & ZEBRA MUSSELS

The South African sabellid worm was imported to the United States in the 1980s in an abalone shipment from South Africa. By 1993, abalone growers in Cayucos, California began to notice defects such as misshapen, stunted and brittle shells in their stock. The worm causes shell lesions that compromise the abalone's overall health and marketability. The worm quickly spread to other abalone farms via seed stock and to rocky intertidal habitat nearby. The resulting infestation spread to native black turban snails. University of California, Santa Barbara researchers removed more than a million infected snails from the area, eradicating the worm from the wild in California. State agencies now closely regulate transfers of abalone between aquaculture facilities and have established a two-year certification program to ensure buyers that shellfish stocks are sabellid-free.

Though not in California, a 2006 success story in early detection marks the first successful extermination of zebra mussels. In 2002, the mollusks were discovered growing in a twelve-acre abandoned rock quarry in Virginia. With neither a native mollusk population nor any surface water outlets, the site was deemed ideal for mussel eradication. In 2006, the quarry was treated for three weeks with twice the concentration of potassium chloride found to be lethal to zebra mussels. Eradication was confirmed by a variety of measurements. Concentrations of potassium chloride in quarry water remained well below levels harmful to other wildlife; turtles, fish, aquatic insects, snails and other wildlife in the quarry do not appear to have been affected by the treatment. Unfortunately, the large volume of potassium chloride required makes the technique impractical to apply in large bodies of water.

Slow the Spread & On-Going Control

When eradication is not feasible, containment or at least a “slow the spread” strategy may be the best choice, particularly when management costs are likely to be exceeded by the environmental, public health or economic losses to businesses dependent on aquatic environments if an invasion is allowed to proceed unmanaged. Control programs often occur over many years, involve multiple sites and waterways, and present a daunting battle to manage the movements of small seeds, spores, larvae and specks of algae across huge landscapes and waterscapes.

Education & Outreach

Regardless of what the management response is, or the scale or type of invasion, it is critical to establish effective, ongoing communication with all those impacted, involved or potentially perpetrating the problem. Education and outreach – whether it is public service announcements and other media campaigns, species identity cards, volunteer training or school programs – play an important role. Education and outreach activities go hand-in-hand with all phases of AIS management, including prevention, early detection and monitoring, rapid response and eradication, and long-term control.

MANAGEMENT EXAMPLES: PURPLE LOOSESTRIFE AND CHINESE MITTEN CRAB IMPACTS

Purple Loosestrife is a wetland invader imported from Europe in the early 1800s for its medicinal value and beautiful purple flowers. A large plant can produce more than two million viable seeds in one season. Purple loosestrife is still sold as an ornamental in nurseries in some states, though at least 24 states, including California, have listed it as a noxious weed and prohibit its sale. In California, it is rapidly expanding its range. State agencies have undertaken an effort to survey state populations and develop management plans. Eradication is the goal where feasible; however, preventing the spread of established populations may be the only alternative in other places. The plant is extremely difficult to eradicate, although a suite of insects has provided effective biological control in some areas.

Although the Chinese mitten crab had previously been found elsewhere in the United States, San Francisco Bay was the first introduction that resulted in the establishment of a population. Burrows excavated by the crabs erode banks and could damage levees. The crab's sharp claws can cut through commercial fishing nets and reduce or damage catch. The mitten crab can also host a human parasite known as the lung fluke, which can cause tuberculosis-like symptoms (the parasite has not been found in California crabs to date). In fall of 1998, as many as 1 million mitten crabs were collected at the federal and state fish salvage facilities in the south delta, which are associated with the California Aqueduct and State Water Project. The crabs clogged the screens, holding tanks and transport trucks used to salvage fish from the pumping stations. The state built "Crabzilla", an 18-foot high traveling fish screen, at its Tracy fish collection facility to scoop up the crabs so they can be hauled off and ground up for fertilizer. Mitten crab numbers declined after 2001 and in 2005 were at very low numbers throughout the watershed (Hieb 2005 in press).

MANAGEMENT EXAMPLES: NATIONAL AWARENESS CAMPAIGNS

Numerous education campaigns seek to improve public awareness of AIS issues on a national level. Habitattitude, for example, was started by the U.S. Fish & Wildlife Service and the national Aquatic Nuisance Species Task Force and the pet industry. This campaign focuses on promoting consumer awareness and responsible behaviors for aquarium and water garden hobbyists and in the industries that serve them. Other national campaigns are already working to educate water users about how to prevent the spread of AIS: Protect Your Waters & Stop Aquatic Hitchhikers is an educational campaign aimed at all recreational users; the 100th Meridian Initiative is a campaign aimed at stopping the spread of the zebra mussel and other AIS into the West. For more information on these national campaigns see Appendices B and D.

An Overview of Current AIS Management Activities in California

Seven state agencies are actively involved in large-scale ongoing AIS management programs. Numerous other local, state and federal agencies, NGOs, universities, research institutions and stakeholder groups, also play a role. Some management programs focus on a specific vector (commercial shipping, aquaculture, etc.), some on specific nuisance species or a group of species (such as agricultural pests) and some on minimizing AIS impacts on protected uses of the state's waters (boating, fishing, wildlife habitat, etc.). More information about the activities of these diverse agencies appears later in this section and in Appendices B, C, and D.

The seven state agencies with lead AIS responsibilities are the California Department of Fish & Game (DFG), the California Department of Food and

Agriculture (DFA), the California Department of Boating and Waterways (DBW), the California State Lands Commission (SLC), the California Department of Water Resources (DWR), the State Coastal Conservancy (SCC), the State Water Resources Control Board (SWRCB) and nine regional water quality control boards (RWQCBs) – see Table 4.

At this time, DFG serves as the coordinating agency for AIS activities, represents the state on the Western Regional Panel (see Appendix D), and as such, has organized the development of this plan and other statewide initiatives to improve AIS management. State weed control programs are managed primarily by DFA, with federal help from the USDA and critical input and cooperation from research, education and related business organizations. As part of this program, DFA, with the help of County Agricultural Commissioners, also manages an exclusion program both at borders and at entry points. Other state agencies manage specific in-the-water and on-the-ground aquatic weed programs – including DBW and SCC.

SLC is the lead implementing agency for the state's ballast water management program. This program implements California regulations requiring vessels arriving from outside the U.S. EEZ and engaged in coastwise travel, to manage their ballast water. As part of this program, DFG/Office of Spill Prevention and Response (DFG/OSPR) conducts biological surveys in port/harbor areas and open coastal areas.

Other state agencies undertake invasive species management activities to enforce mandates such as the protection of commercial fisheries and sensitive wildlife by DFG, in cooperation with federal agencies such as USFWS, the maintenance of state water supplies and protection from flooding by DWR and the protection of the beneficial uses of state waters and water quality by SWRCB and RWQCBs. Across the state, local districts work to control mosquito populations to protect human and livestock health. All these state efforts to manage AIS are supported by the cooperative work and research provided by universities, NGOs, federal agencies, local agencies and stakeholder groups.

Table 4: Lead AIS Agency Contacts in California (as of April 2007)		Vectors	Invaders
California Department of Boating and Waterways (DBW)	Marcia Carlock mcarlock@dbw.ca.gov (916) 263-8142 http://www.dbw.ca.gov/	Recreational boating	water hyacinth Brazilian elodea
California Department of Fish and Game (DFG)	Susan Ellis sellis@dfg.ca.gov (916)653-8983 http://www.dfg.ca.gov/	Aquaculture Commercial Fishing Live fish and animal transportation and imports	fish aquatic organisms and plants algae (<i>Caulerpa</i>)
	Marian Ashe mashe@ospr.dfg.ca.gov (916)324-9803 http://www.dfg.ca.gov/ospr/	Ballast water (biological surveys)	estuarine and marine invasives
California Department of Food and Agriculture (DFA)	Patrick Akers pakers@cdfa.ca.gov (916)654-0768 http://www.cdfa.ca.gov/	Nurseries Agriculture	Hydrilla and other regulated aquatic weeds agricultural pests
California State Lands Commission (SLC)	Maurya Falkner falknem@slc.ca.gov (916)574-2568 http://www.slc.ca.gov/Spec_Pub/MFD/Ballast_Water/Ballast_Water_Default.html	Commercial shipping: Ballast water Vessel fouling	estuarine and marine invasives
	Eric Gillies gilliee@slc.ca.gov (916)574-1897	Construction Restoration	freshwater, estuarine and marine invasives
California Department of Water Resources (DWR)	Jeff Janik jjanik@water.ca.gov (916) 653-5688 http://www.water.ca.gov/	Water supply and delivery systems Flooding	riparian weeds mitten crab aquatic food web
The State Coastal Conservancy (SCC)	Abe Doherty adoherty@scc.ca.gov (510)286-4183 http://www.coastalconservancy.ca.gov/	Coastal preservation Restoration	<i>Spartina</i> <i>Arundo</i> wetland invasives
State Water Resources Control Board (SWRCB)	Dominic Gregorio dgregorio@waterboards.ca.gov (916)341-5488 http://www.waterboards.ca.gov/	Discharges Runoff	general exotics

For detailed information on these and other state, federal and local agencies involved in AIS management see Appendices B, C & D.

As this plan is intended primarily for internal state coordination, the focus of the following sections of this chapter is on state agency activities. This section is intended as an overview. A more comprehensive description of state agency responsibilities appears in Appendix C and overlaps somewhat with the overview below.

Biological Surveys, Environmental Planning & Enforcement

DFG is the state trustee agency for fish, wildlife and native plants and plays a major role in managing invasive species that have negative impacts on these resources. Numerous programs and laboratories within DFG work on AIS detection and/or control, including DFG's Invasive Species Program which coordinates statewide AIS activities and undertook the development of this statewide AIS management plan and the associated rapid response plan. DFG is responsible for enforcement of regulations concerning: the aquaculture industry; recreational fishing; commercial fishing; the importation and transport of live wild animals, aquatic plants and fish into the state; and the placement of any such animals in state waters. Recent programs have focused on *Caulerpa* (see Chapter 8), northern pike (see below), quagga mussel, and New Zealand mudsnail, among others.

DFG is also responsible for conducting biological surveys to assess the amount and types of AIS present in state waters. Starting in 1999 with ballast management legislation, DFG/OSPR conducted biological surveys to determine the degree of success of ballast water management activities. The first survey of major ports, harbors and bays of California helped determine a baseline of nonindigenous aquatic species introduced from the ballast of ocean-going vessels. The survey revealed that all areas of the California coast have experienced some level of invasion by species not native to California. Since then, DFG/OSPR has revisited baseline monitoring sites and expanded monitoring to include intertidal and subtidal habitats at 22 outer coast sites. DFG/OSPR also manages the California Aquatic Non-Native Organism Database (CANOD) for marine and estuarine species and is working to establish consistency among the various major databases being used to analyze similar types of AIS-related information. Lastly, DFG has been an active manager or partner in numerous AIS eradication and control programs – especially those AIS that threaten or undermine the health of endangered species or the conservation and restoration of the aquatic ecosystem.

Aquatic Weed Control & Plant Pests

DFA has long regulated and managed aquatic and terrestrial weeds, with a particular emphasis on those that are agricultural pests or cause economic harm. DFA activities and regulatory authority include quarantine, exterior pest exclusion (border protection stations and inspections), interior pest exclusion (pet/aquaria stores, aquatic plant dealers, and nurseries), and detection and control/eradication programs. DFA maintains a rated list of noxious weed species, which, depending on the rating, require various levels of eradication,

containment or holding actions. For all plants, the DFA Plant Pest Diagnostic Center identifies plant species and assigns plant pest ratings. In 2005, DFA and the California Invasive Weed Awareness Coalition completed the state's first comprehensive *Noxious and Invasive Weed Action Plan* (CDFA and CALIWAC 2005), whose recommendations as they relate to aquatic weeds have been taken into account in this AIS plan. One of DFA's largest aquatic weed management programs is a statewide effort to eradicate the escaped aquarium plant *Hydrilla* (see Chapter 2). The County Agricultural Commissioners (CACs) work closely with the state's pest prevention program. In northern California, CACs carry out many quarantine inspections and manage a weed eradication program.

MANAGEMENT EXAMPLE: CONTROLLING NORTHERN PIKE

California's northern pike infestation is currently limited to just one lake. This native of northern waters from Asia to Europe and from Alaska to the Great Lakes Region, is a voracious predator that can grow up to 40 pounds in North America. It uses sharp teeth to eat creatures ranging from smaller fish such as juvenile salmonids to frogs, crayfish and even ducks. After introduction, it has the potential to dominate water bodies such as lakes, by both preying on and out-competing trout and other game fish. The northern pike poses a major threat to California's aquatic ecosystems, in particular the freshwater species of the Sacramento-San Joaquin Delta. The northern pike was introduced to California on at least two occasions, possibly by anglers hoping to establish a local population of this popular game fish. It was first found in Frenchman Lake, Plumas County, in 1988.

In 1991, Frenchman Lake and its tributaries were treated with rotenone; subsequent testing indicated no pike survived. In 1994, the pike was discovered again in nearby Lake Davis, another Sierra Nevada reservoir. In 1995, DFG proposed to treat Lake Davis with rotenone in order to protect the area's thriving trout fishery, as well as downstream aquatic resources, by eliminating the chance of pike escaping to other waters. Residents strenuously opposed the plan, citing contamination of their drinking water supply. By 1997, the lake's trout population had been virtually eliminated by pike predation. Local businesses, many of which depend on visiting fishermen, began to suffer. Despite the controversy surrounding the proposed project, a treatment occurred in October 1997. Over 55,000 dead pike were removed from the lake and the treatment was declared successful. In 1999, just 17 months after treatment, more pike were found in Lake Davis. It is unknown whether fish survived the treatment or pike were illegally introduced after the treatment. After the fish were rediscovered in Lake Davis, DFG commenced trapping, electrofishing, netting, and increased law enforcement and education on the dangers of pike introduction. Yet fish numbers in the lake have continued to rise. In 2005, DFG proposed a project to eradicate northern pike in Lake Davis. The proposed project includes application of rotenone in combination with a significant reservoir drawdown; the drawdown would reduce the amount of chemical needed to kill the pike. DFG, in cooperation with the U.S. Forest Service, Plumas National Forest, are currently engaged in a joint state and federal environmental review process for the proposed project and seven alternatives. Both agencies are working closely with the local community and local, state and federal agencies to avoid the controversial nature of the chemical treatment that occurred in 1997.

MANAGEMENT EXAMPLE: QUARANTINES & INSPECTIONS

California has a long history of state-imposed quarantines and exclusionary practices dating back over a century. These quarantines have prevented or limited the entry of many invasive species and diseases such as Mediterranean fruit fly and exotic diseases that developed from farmed salmon and other fish. At the height of California's quarantine and inspection programs, DFA operated 16 full-time Border Protection Stations (BPS), staffed by over 150 inspectors, to inspect all vehicles entering the state for quarantine compliance. Additionally, the CACs conducted enforcement activities at plant and produce import sites and aquaculture facilities. In recent years, funding for these programs has diminished and resources are not available to keep up with increases in invasions due to growth in U.S. and global travel and mail order and Internet sales of live organisms and plants. DFA funding for BPS alone dropped from \$11 million in 2002 to \$9.2 million in 2005 and private vehicle inspections (including trailered boats and other watercraft) had until recently been eliminated.

Zebra mussel infested watercraft were intercepted at the BPS 68 times between 1993 and 2006. Over half of these finds were from private vehicles, which are not being inspected today. DFA is in the process of conducting a pilot project at one station (Needles on I-40) to determine the pest introduction risk presented by private vehicles. Since this project began on July 5, 2006, zebra mussel has been intercepted four times on private vehicles. Hydrilla has also been intercepted from a private vehicle during this pilot. Increased levels of inspection and enforcement are critical to the prevention of new AIS introductions (Leslie, Pers. Comm. 2007). The discovery of quagga mussel in Lake Mead in January 2007 allowed state agencies to access emergency funds to increase staffing, and permanent funding became available July 1, 2007.

DBW manages the state's largest and oldest aquatic weed control program, working with other public agencies to control the widespread water hyacinth (see Chapter 2) – and more recently Brazilian elodea – in the Sacramento-San Joaquin Delta, its tributaries and the Suisun Marsh. In addition to managing these weed control programs and attempting to keep waterways free of the navigational problems they pose, DBW also manages the recreational boating vector of AIS in California (although currently there is not funding and staff for a comprehensive program). DBW leads the California Clean Boating Network – a collaboration of government, business, boating and academic organizations working to increase and improve clean boating education efforts, including invasive species education, across the state.

SCC has been involved for over twenty years in the control and eradication of aquatic invasives, particularly plants. Most recently, its management focus has been on developing, funding and operating the Invasive Spartina Project in San Francisco Bay (see Chapter 8 and Appendix B). The project's aim is to eradicate four invasive species of *Spartina* (and their hybrids), which threaten to destroy marsh and mudflats and clog drainage channels. SCC is also heavily involved in efforts to control *Arundo* in many coastal watersheds and has been a partner in developing this state AIS management plan.

Commercial Shipping Management (Ballast Water and Vessel Fouling)

SLC oversees management of AIS introductions through commercial shipping as directed by the 2003 Marine Invasive Species Act. This program implements regulations governing ballast water management for vessels arriving or operating on the West Coast of North America. Commission inspectors board approximately 25% of all vessels that arrive to California to verify compliance with regulations and to disseminate outreach materials to vessels and crews new to California (Falkner et al. 2007). Monitoring results suggest that vessel compliance with the requirement to report ballast management and discharge practices is very high (see Figure 4) and has risen dramatically since the inception of the program. The majority of non-compliant ballast water discharge originating from outside U.S. waters is from Mexico (Falkner et al. 2007).

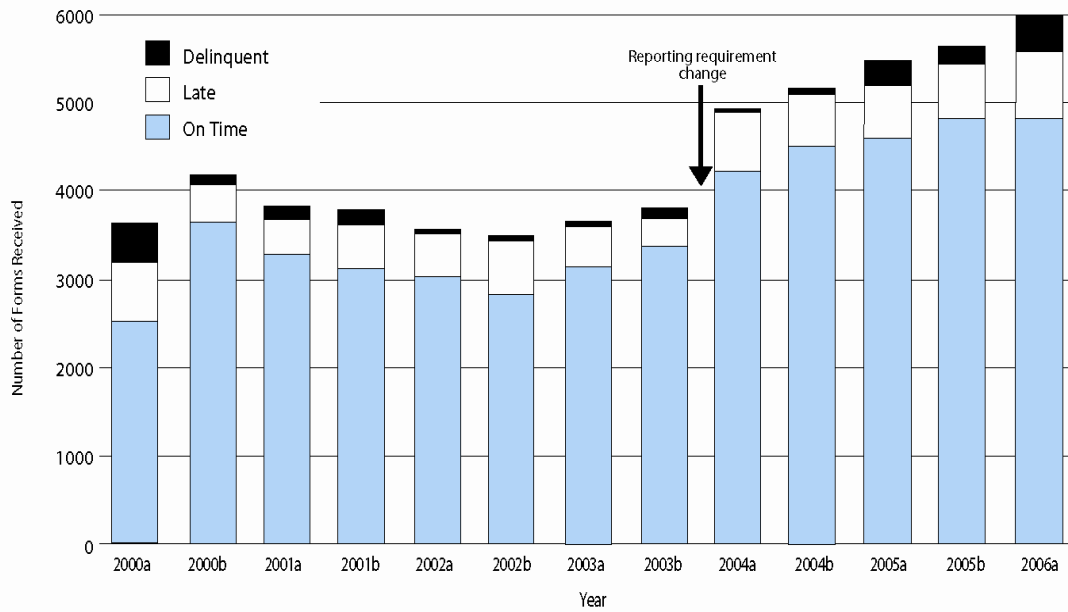
The high compliance rates are attributable to the multi-pronged outreach and communication activities undertaken by SLC. Inspectors distribute information about regulations verbally and in print to crews. Agents are notified monthly of their vessels' reporting compliance or non-compliance. Multi-agency, multi-interest advisory groups are regularly convened and consulted regarding evolving policy considerations. New legislation (2006) directs SLC to develop regulations requiring vessel owners and operators to implement certain interim and final performance standards for the discharge of ballast water. In addition to the regulatory activities described above, SLC facilitates scientific research and technology development to enhance management efforts of the ballast water program and to inform policymakers.

SLC has also developed recommendations for preventing AIS release from hull fouling on commercial vessels. In follow up to the Marine Invasive Species Act of 2003, which directed SLC to formulate these recommendations, SLC collaborated with the California Sea Grant Extension Program on a May 2005 workshop. This workshop was designed to discuss the vessel fouling issue with stakeholders from both the recreational boating and commercial shipping communities (Gonzalez and Johnson 2005). Information gathered from this workshop and from several additional advisory group meetings, was incorporated into a set of final recommendations presented to the state legislature in 2006 (Takata et al. 2006). In addition to its commercial shipping-related activities, SLC is also engaged in regional AIS projects that affect waters that fall under their jurisdiction, such as coordinating interagency efforts to manage Eurasian watermilfoil in Lake Tahoe (see Chapter 8).

Figure 4: Ballast Water Reporting and Discharge Rates

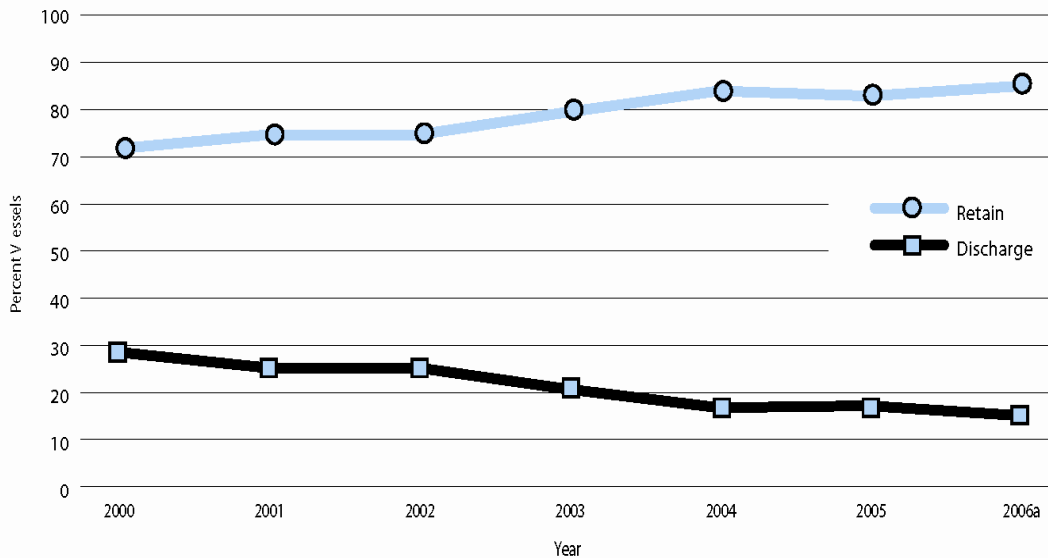
Ballast Water Reporting

Vessel compliance with requirement to submit information on ballast water management practices to the State Lands Commission. The x-axis is divided into 6-month intervals (a = January-June; b = July-December). Since 2004, compliance has remained above 94% with approximately 85 % of vessels reporting on time (upon departure from port). (Source: Falkner et al. 2007)



Ballast Water Discharge vs. Retention

Percent of vessels discharging in CA waters (squares) compared to percent of vessels that retain ballast water (circles). Only the first 6 months of 2006 are represented in this graph. Since 2000, the percentage of vessels discharging has steadily decreased. Ballast water retention is currently the most protective management option available. (Source: Falkner et al. 2007)



Monitoring & Managing AIS Impacts on Water Quality & Supply

DWR addresses invasive species issues that impact water supply and delivery and flood control. Recent management activities have focused largely on monitoring AIS within the water column and food web, developing key early detection programs and undertaking structural improvements such as a barrier at Lake Davis (to prevent northern pike escape) and a screen at the State Water Project (to collect Chinese mitten crabs). In terms of monitoring, DWR conducts monthly monitoring of benthic (bottom-dwelling) invertebrates, zooplankton and phytoplankton throughout the upper San Francisco Estuary. DWR also documents the distribution of the invasive algal species *Microcystis* spp. (both toxic and non-toxic strains) in this estuarine region. DWR is also investigating the impacts of the Chinese mitten crab on the benthic invertebrate community in the Sacramento-San Joaquin Delta. On the early detection front, DWR was most recently responsible for implementing the California Zebra Mussel Watch Program (which included risk assessment, early detection, public outreach and the development of a rapid response plan for the Central Valley watershed and a centralized reporting system for mussel sightings). DWR also participates in programs aimed at controlling invasive weeds along eroding Sacramento River banks, within flood control and water conveyance structures and along urban streams. The agency coordinates its activities with other state and federal agencies as a member of the CALFED Non-Native Invasive Species Advisory Council.

The SWRCB, and the nine affiliated regional boards, have no specific policies and programs related to AIS but have been working in support of and in an advisory capacity to, other state agencies on various related activities such as hull fouling and ballast water management. AIS come under SWRCB purview as part of the state's responsibilities under the federal Clean Water Act (CWA, see Appendix B). A 2005 federal court ruling defined nonindigenous species as "pollutants" present in discharges from vessels and found that such discharges are not exempt from permitting requirements (see National Pollutant Discharge Elimination System (NPDES) permits in discussion of the CWA in Appendix B).

In terms of AIS management activities, some of the regional boards have also sought to place specific water bodies within their regions on the CWA's 303(d) list, as impaired by "exotics" (see Glossary). San Francisco Bay was listed in 1998. In 2006, the State Board also listed the Delta, the upper San Joaquin River and the Cosumnes River. Once on the 303(d) list, the regional boards are required to develop discharger/source based programs for managing pollutant loads (called Total Maximum Daily Loads or TMDLs), which in the case of AIS have proved somewhat difficult to develop. Trying to allocate loads or goals for zero loads, among dischargers, water users and municipalities is challenging when most of the water bodies in question are already heavily invaded. Despite the implementation challenges, the S.F. Bay RWQCB's work on the state's first exotics TMDL did widely publicize the problem and led to other successful AIS management and legislative programs.

Other regional boards have become involved in AIS-related water quality issues through watershed management projects, non-point source pollution management programs and wetland mitigation and restoration programs (raising issues about the use of non-native aquatic plant species for these programs, and the control of invasives, for example). The SWRCB has also participated in AIS management activities concerning the use of aquatic pesticides and the nine regional water quality control boards enforce the statewide NPDES permit for use of aquatic pesticides for weed and vector control.

Education & Outreach

Most of the AIS management programs described in this chapter involve some education and outreach. There are many other outreach activities, large and small, conducted by public and private organizations interested in the prevention and control of AIS infestations. The University of California Cooperative Extension (UCCE) and California Sea Grant Programs (Sea Grant), for example, are active and successful leaders in invasive species outreach and education. They have built substantial stakeholder networks and brought media attention to AIS concerns. Other groups engaged in AIS outreach and education include CALFED, the San Francisco Estuary Project, the San Francisco Estuary Institute, National Estuarine Research Reserves and Marine Sanctuaries, the Pacific States Marine Fisheries Commission and the California Invasive Plant Council, among others (see Appendix D).

Partnerships with NGOs, Business & User Groups

Many of the state's AIS management activities are undertaken through partnerships with local agencies, non-governmental organizations (NGOs), private landowners and various interest groups. Those currently active range from large environmental and land-holding organizations such as the Nature Conservancy to smaller county land trusts, Native American tribes, watershed management organizations, and special interest groups (fishing, hunting, boating, etc.). Business groups affected by AIS management activities (shippers, aquarium trade, habitat restoration companies, etc.) have also been active partners in AIS management. A number of task forces and projects are dedicated to very specific invaders (see Appendix D). Such groups and organizations can greatly help state and federal efforts to manage AIS.

Partnerships with Universities, Research Institutes, Industry & Consulting Firms

The management activities mentioned in the preceding sections were possible because of the research conducted by universities, relevant industries public/private research and resource management organizations. Increased knowledge of the biology of invasive species and associated control methods allows for the most effective management of AIS. Research is needed to quantify and clarify the effects that non-native species are having on native plants, animals and their habitats. It is also important to know what economic effects AIS are having and whether there are any human health and safety

concerns resulting from an infestation. These partnerships are necessary in order for agencies to develop their management programs with scientific input.

Gaps & Challenges

Factors such as the large size of the state, the number of organizations/constituencies involved and other geographic and water management issues complicate California's efforts to prevent AIS introduction and manage their spread. California, like other states, suffers from the following challenges to effective AIS management:

- Difficulty in balancing negative environmental impacts of chemical treatment with positive protection of native habitats and listed species
- Difficulty in timely permitting for rapid response, eradication and control
- Lack of adequate long-term funding
- Difficulty coordinating diverse state activities, agencies and programs, and ensuring communication and high-level priority setting to optimize limited management resources
- Lack of awareness of, and enforcement of, existing laws
- Limited detection and treatment technologies, and coordination among detection efforts
- Limited public awareness of the threats posed by AIS, and costs of managing AIS, versus the threats from pesticides used to control them

This management plan is a substantial step toward addressing these challenges. It emphasizes coordination, communication and prevention; suggests actions to fill management gaps and provides a foundation for California's first comprehensive state-wide approach to AIS.

5. SUMMARY OF AIS LAWS, REGULATIONS & AUTHORITIES

The primary authority for state efforts to prevent AIS introduction and manage the spread and impacts of AIS in state waters derives from California's Fish and Game Code, the Food and Agriculture Code, and the Public Resources Code. Other significant statutes discussed below are found in the California Water Code and the Harbors and Navigation Code. These codes are the actual state laws passed by the legislature. Relevant state commissions are charged with adopting regulations that are necessary to carry out the intent of these laws. The regulations are added to the relevant divisions within the California Code of Regulations. Various federal laws also impact management activities. For a more comprehensive description see Appendices B & C.

California Authorities

Fish and Game Code & Title 14 of the California Code of Regulations

At least five code sections and their associated regulations address or relate to AIS. The intent of these code sections are to regulate the importation and transportation of live wild animals and plants; restrict the placement of live aquatic animals or plants in state waters; and regulate the operation of aquaculture industries. DFG is the state agency responsible for implementing these statutes.

F & G Code §§ 2080–2089, 2118, 2270-2272, 2300, 6400-6403, 15000 et seq.
<http://www.fgc.ca.gov/html/regs.html>

California Food and Agriculture Code

Over 30 different code sections address the state's mandates to prevent the introduction and spread of injurious animal pests, plant diseases and noxious weeds. These codes describe procedures and regulations concerning, among other things: plant quarantines; emergency pest eradications to protect agriculture; pests as public nuisances; vectors of infestation and infection; the sale, transport and propagation of noxious weeds; and the protection of native species and forests from weeds. Most of these statutes and their associated regulations (Title 3 of the California Code of Regulations) are enforced by DFA.

F & A Code §§ 403, 461, 5004, 5021-5027, 5301-5310, 5321-5323, 5401-54204, 5421, 5430-5432, 5434, 5761-5763, 7201, 7206-7, 7501-2
www.leginfo.ca.gov

California Water Code

The Porter-Cologne Water Quality Control Act (California Water Code, Division 7) lists a number of types of pollutants that are subject to regulation. Section 13050, for example, specifically includes the regulation of "biological" pollutants by defining them as relevant characteristics of water quality subject to regulation by the SWRCB and the affiliated RWQCBs. AIS are an example of this kind of pollutant if they are discharged to receiving waters. The Water Code generally regulates more substances occurring in discharges and also defines discharges to receiving waters more broadly than the federal CWA.

Water Code §13050

Harbors & Navigation Code

This code authorizes DBW to manage aquatic weeds impeding the navigation and use of state waterways.

Article 2, Section 64

Public Resources Code

Sections of this code address the state's mandates to prevent nonindigenous species introductions through ballast water of commercial vessels. These sections were promulgated by the three laws described below. The SLC and the DFG have primary responsibility for carrying out these statutes and associated regulations.

The Ballast Management for Control of Nonindigenous Species Act of 1999 required that commercial vessels over 300 gross register tons (GRT) originating from outside the U.S. EEZ carry out mid-ocean exchange (at least 200 nautical miles offshore) or use an approved ballast water treatment method, before discharging in California state waters. State enforcement of the act took the form of monitoring ballast discharges and reports, inspecting vessels for compliance and assessing vessel reporting rates and compliance.

The Marine Invasive Species Act was passed in 2003, widening the scope of the original program. The 2003 act requires ballast water management for all vessels that intend to discharge ballast water in California waters, though the regulations differ depending on voyage origin. All qualifying vessels coming from ports within the Pacific Coast region must conduct an exchange (in waters at least 50 nautical miles offshore and 200 meters deep), or retain all ballast water and associated sediments. All vessels must complete and submit a ballast water report form upon departure from each port of call in California. They must also comply with good housekeeping practices, ranging from avoiding discharge near marine sanctuaries to rinsing anchors and removing fouling organisms from the hull. They must also keep logs of ballast management activities, conduct crew training and pay a fee for each qualifying voyage at their first port of call in California. To determine the effectiveness of the management provisions of the act, the legislation also requires state agencies to conduct a series of biological surveys to monitor new introductions to coastal and estuarine waters.

The Coastal Ecosystems Protection Act of 2006 deleted the sunset provision of the prior statute making the Marine Invasive Species Program permanent. The new law also requires adoption of regulations that will require vessel owners to implement certain interim and final performance standards for the discharge of ballast water and establishes an on-going coastal AIS monitoring program to be implemented by DFG.

PR Code §§ 71200-72423; CC 2271; RT 44008

Regulated Species

For a list of AIS plant and animal species regulated by the state see Appendix G.

Primary Federal Authorities & Agencies

California's AIS management efforts must also be coordinated with the federal government's extensive efforts on the same front. No single federal agency has comprehensive authority for all aspects of aquatic invasive species management. Federal agencies with regulatory authority over the introduction or transport of aquatic species that may be invasive or noxious include the U.S. Department of Agriculture, Animal Plant Health Inspection Service, the U.S. Department of Agriculture, Agricultural Marketing Service, the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Commerce and the U.S. Coast Guard (USCG). Additionally, many other agencies have programs and responsibilities that address components of AIS, such as importation, interstate transport, exclusion, control and eradication. One of the earliest authorities derives from the 19th-century Rivers & Harbors Act, which enables the U.S. Army Corps of Engineers to control aquatic weeds.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) established the first major federal program to prevent the introduction and control the spread of introduced aquatic nuisance species. The act provides an institutional framework that promotes and coordinates research, develops and applies prevention and control strategies, establishes national priorities, educates and informs citizens and coordinates public programs. The act also calls upon states to develop and implement comprehensive state AIS management plans, such as this California plan. In 1996, the National Invasive Species Act (NISA) amended the 1990 act to mandate ballast water exchange for vessels entering the Great Lakes and to implement voluntary ballast water exchange guidelines for all vessels with ballast on board that enter U.S. waters from outside the U.S. EEZ. The act also authorized the USCG to toughen requirements if compliance proved unsatisfactory, which it did in 2004. As a result, the USCG has since established mandatory ballast water management requirements for all ships entering U.S. waters and penalties for non-compliance.

The NANPCA/NISA does not affect state authority to adopt or enforce AIS control measures. Several states have elected to undertake such measures. In addition to reporting requirements, California, Oregon and Washington have ballast water exchange requirements. California law (2006) requires the state to adopt a ballast water discharge standard.

The Executive Order on Invasive Species signed by President William J. Clinton on February 3, 1999, expanded federal efforts to address AIS. The order intended to build upon existing laws, such as the National Environmental Policy Act, the Nonindigenous Aquatic Nuisance Prevention and Control Act, the Lacey Act, the Plant Pest Act, the Federal Noxious Weed Act and the Endangered Species Act. The order creates a National Invasive Species Council charged with developing a comprehensive plan to minimize the economic, ecological and human health impacts of invasive species and determine the steps necessary to prevent the introduction and spread of additional invasive species. Federal

activities are now coordinated through this council and through the National Aquatic Nuisance Species Task Force (ANSTF).

Beyond authorities and legislation, some of the other major federal activities related to AIS management in California include:

- USFWS' 100th Meridian Initiative to stop the zebra mussel from spreading west.
- NOAA's Sea Grant Program, and its support for the West Coast Ballast Outreach Project (which educates the maritime industry about the ecological impacts of aquatic invasive species), as well as funding research on key invasive species.
- USDA's federal noxious weed list, maintained through the APHIS Cooperative Agricultural Pest Survey, and its Agricultural Research Service (ARS) units at Davis and Albany, California, whose work includes improving management of invasive aquatic and riparian weeds affecting agriculture and natural resources.
- USEPA's recent commitment to providing federal coordination for AIS rapid response planning and associated permitting.
- USGS' ongoing research and data bases on invasive species.
- NPS inventories and monitors invasive species and, where feasible, strives to eradicate them.

For more detailed information on federal AIS authorities, agencies and programs, see Appendix B or visit <http://www.anstaskforce.gov> and www.invasivespecies.org.

6. MANAGEMENT OBJECTIVES, STRATEGIES & ACTIONS

PLAN GOAL: Minimize the harmful ecological, economic and human health impacts of aquatic invasive species.

To assist in attaining the goal of the California AIS Management Plan (CAISMP), eight major objectives have been identified:

1. **COORDINATION & COLLABORATION:** Improve coordination and collaboration among the people, agencies, and activities involved with AIS.
2. **PREVENTION:** Minimize and prevent the introduction and spread of AIS into and throughout the waters of California.
3. **EARLY DETECTION & MONITORING:** Develop and maintain programs that ensure the early detection of new AIS and the monitoring of existing AIS.
4. **RAPID RESPONSE & ERADICATION:** Establish and manage systems for rapid response and eradication.
5. **LONG-TERM CONTROL & MANAGEMENT:** Control the spread of AIS and minimize their impacts on native habitats and species.
6. **EDUCATION & OUTREACH:** Increase education and outreach efforts to ensure awareness of AIS threats and management priorities throughout California.
7. **RESEARCH:** Increase research on the baseline biology of AIS, the ecological and economic impacts of invasions, and control options to improve management.
8. **LAWS & REGULATIONS:** Ensure state laws and regulations promote the prevention and management of AIS introductions.

Associated strategies and specific actions pertaining to each of the above objectives are presented in this chapter. These actions have been identified as being key tasks necessary to more effectively manage aquatic invasive species. The proposed objectives, strategies and actions in this plan should be regularly reviewed and incorporate annual opportunities for updates and adaptation to new knowledge and circumstances.

Plan Development Process

The plan goal, objectives, strategies, and specific actions were developed with input from a series of stakeholder scoping meetings, interagency staff communications and public workshops held in 2002 and 2006 (Appendix E).

Implementing Entities & Cooperating Organizations

The entities listed as acronyms, in bold type, in parentheses after each action represent the suggested key implementing entities (see the acronym list in the front material of this plan). In most cases, this refers to those state entities that have the responsibility and/or authority to implement the appropriate actions. Federal, regional and local agencies will, in most cases, not be listed as implementing agencies, since this is a state plan. The acronyms of cooperating organizations, who can participate in implementation efforts, are listed in normal type.

State agencies will coordinate with federal, regional, and local agencies whenever appropriate. The need for particular coordination with federal agencies is noted with an "FA" in the list of implementing entities and cooperating organizations. When an action requires input or products from universities, colleges, academic institutions or research organizations, the generic label "RI" (research institutions) will be used. These include the state government's primary research arms – California State Universities and the University of California – as well as the California Sea Grant program. Some of these entities are listed specifically after appropriate actions per their request, rather than being listed generically as RI. For many actions the Aquatic Invasive Species Working Group (AISWG) is included as a responsible entity. This implies that representatives of all AISWG entities will have the opportunity to be involved in these actions.

The CAISMP Implementation Matrix (Table 5, Chapter 7) lists implementing entities and cooperating organizations. The listings presented here are only a guideline, and as implementation progresses, the implementing entities may change.

Year & Funding

The year associated with each of the tasks indicates the suggested year in which to begin implementation. Year 1 indicates that funding and personnel resources are already available for FY 2007/2008, or that the action is a high priority for which resources need to be secured as quickly as possible. For some of these actions, suggested implementation years may seem overly optimistic, especially those that require funding beyond what is currently available. Like many other states across the nation, California is currently undergoing budgetary restrictions and financial support for many of these actions is uncertain. The purpose of this plan however, is to represent what should, rather than what is likely to, happen if California is to adequately address its aquatic invasive species problems on a statewide basis. Actions aimed at securing more funding appear under Objective 1.

Discussion

Many details are included with the following actions. “Discussion” statements are included with many of the following actions to provide more specific direction to implementing agencies.

OBJECTIVE 1: COORDINATION & COLLABORATION

Improve coordination and collaboration among the people, agencies and activities involved with AIS.

AIS management activities conducted by the state spread across multiple agencies. State managers coordinate specific AIS activities through a variety of venues and networks, but without the benefit of a formal coordinating framework. The actions under this objective seek to describe a new coordinating framework that will allow for the comprehensive assessment of AIS activities and ensure action on high priorities. This coordinating framework includes: an executive level consultation process through which state agencies may gain policy level direction and support for AIS management; the establishment of an Aquatic Invasive Species Working Group (AISWG) made up of representatives from various agencies, research institutions and stakeholder groups; and the formal creation of a California AIS Team (CAAIST) of lead AIS managers from each state agency and/or department. The work of the AISWG and the CAAIST will be assisted by the development of technical advisory panels. These panels will provide forums for federal agencies, local agencies, research institutions, NGOs, Native American organizations, and stakeholders to address questions within a specific topic (such as management techniques, specific species or particular geographic areas). In addition to these standing technical advisory committees, several ad hoc committees are likely to be formed.

STRATEGY 1A: INTERNAL STATE COORDINATION

Identify and coordinate agencies, programs and representatives within state government involved with AIS.

ACTIONS

1A1. Develop an executive level consultation process for state agencies involved with AIS management.

(AE, CAAIST, RI, NGOs, SH) Year 1

Discussion: Coordination and consultation at the executive level are central to statewide policy level direction and planning. This direction could include legislation, funding and program direction for all state departments responsible for addressing invasive species issues. This can be accomplished by regular briefings to agency and department directors by key state AIS managers. Alternatively, it could be accomplished by the formation of an AIS or Invasive Species Council made up of department and agency upper management. If such a council for executive level coordination and consultation were pursued, the costs and benefits should first be assessed. In the absence of an AIS or Invasive Species Council, coordination could be accomplished through the California Biodiversity Council. In addition, periodic briefings should be made to the Ocean Protection Council and Fish and Game Commission. Briefing agency and

department executives and involving them more routinely in decision making should improve statewide coordination.

1A2. Formalize the California Agencies AIS Team (CAAIST) made up of representatives from each state agency involved with AIS, and have the team meet regularly.

(AE) Year 1

Discussion: Each state agency and/or department has identified a lead representative for AIS work. This team will meet regularly to coordinate implementation of the state AIS plan. This team will report to executive level managers to implement actions in the plan (Action 1A1) and be led by DFG's State Invasive Species Coordinator.

1A3: Establish, fund and staff an Aquatic Invasive Species Working Group (AISWG) made up of representatives from state and federal agencies, NGOs, stakeholder groups and research institutions, and have the group meet regularly.

(AE, CAISST, RI, NGOs, SH) Year 2

Discussion: The complexity of aquatic invasive species management demands regular peer review to ensure that research, monitoring, prevention and management actions are using the best available approaches. It also demands some broader public and private involvement in forums in which the status of invasive species, control efforts, funding opportunities and criteria for setting priorities are discussed. Forming this new working group could increase the level of collaboration and coordination on AIS throughout the state by creating a regular venue to discuss priorities, pool expertise and reduce redundancies. Any such group would require staff to set up meetings, follow up on action items and handle time-sensitive inquiries and issues that need to be addressed between scheduled meetings. The AISWG is listed as an implementing entity or cooperating organization for many actions in this plan. If the AISWG is not formed, the CAAIST (see 1A2) will become the responsible entity and integrate input from research institutions, NGOs and stakeholder groups into appropriate actions.

1A4. Evaluate the need for an invasive species center.

(AE, NGOs, RI, SH, CAAIST) Year 1

Discussion: Statewide coordination of research and outreach activities could improve by establishing a research network which could incorporate an invasive species center. Defined goals and roles and dedicated funding would be essential to the success of any such entity.

1A5. Form and fund technical advisory panels to provide input to the AISWG and CAAIST and to address specific issues within the plan.

(CAAIST, AISWG) Year 2

Discussion: This plan proposes to convene technical advisory panels to address specific research, management and implementation issues. In addition to state agency staff, the panels will be made up of representatives from the following groups: federal agencies, local agencies, research institutions, NGOs, Native American organizations and stakeholders. It is anticipated that Plan Implementation and Science Advisory panels will be the first to be formed, with other panels created as necessary over time.

1A6. Draft and regularly review working lists of AIS of high-priority concern for early detection actions 3A1-6, rapid response action 4A3 (also see Appendix A, Section IV, Task 7) and control actions such as 5B4.

(CAAIST, FA, RI, Sea Grant, UCCE, NGOs, SH) Year 1 and ongoing

Discussion: One approach would be for the appropriate technical advisory panel (Action 1A5) to review existing national lists, filter these lists through state screening criteria and edit the list based on California-specific conditions and constraints. Draft lists could be circulated for peer review, subsequently finalized by the panel, and submitted to the CAAIST and the AISWG for approval. Lists could then be posted on state websites and updated biennially.

1A7. Clarify which state agencies have lead jurisdiction for more specific AIS issues related to particular species, habitats, water bodies or invasion vectors.

(AE, CAAIST) Year 1

Discussion: Current agency mandates and jurisdictions need to be reviewed, clarified and documented in the context of this statewide plan and discussed by the CAAIST, AISWG and Agency Executives. State AIS managers, local governments, NGOs, stakeholders and others involved in AIS activities, need to be clear about which state agency handles what and why. Such a clarification exercise is an important step in documenting different agency mandates, integrating the many different programs addressing diverse AIS issues, avoiding duplication and ensuring cost-effective use of limited resources. The results of this clarification exercise will be documented and distributed in a report.

1A8. Identify personnel needs within appropriate agencies. Employ needed personnel, to focus on high priority AIS issues and plan implementation.

(AE, CAAIST) Years 1-3

Discussion: This action is already underway. The Governor approved an allocation of \$5.7 million that includes the establishment of 16 new positions in DFG and a \$2.5 million allotment to DFA to work on aquatic invasive species, focusing on quagga mussel prevention, control, eradication, research and outreach.

1A9. Improve state websites to make information on AIS management activities, and research and data, more accessible.

(CAAIST) Year 2

Discussion: State websites and databases on AIS are diverse and reflect different agency mandates and capabilities. To the extent possible, state websites should be improved and linked to facilitate access to current information on management activities statewide, as well as on the latest AIS related technological improvements, data and research. Such accessibility improvements to websites and databases, and linkages among state and other AIS databases, will improve statewide coordination and assist managers and researchers with revisions of this plan and setting action priorities. Efforts under this action will be coordinated with early detection and monitoring actions under Objective 3 and with education and outreach actions under Objective 6, to the greatest extent possible. In addition, whenever possible and useful, biological surveys and other data collected in California databases should be provided, and or developed in compatible formats with, national AIS databases managed by USGS and the Smithsonian Environmental Research Center.

1A10. Assess the effectiveness of AIS programs and projects undertaken by state agencies. Identify and address any gaps in these activities.

(AISWG, Plan Implementation Panel) Year 2

Discussion: The Implementation Panel will review and assess the effectiveness of ongoing AIS management activities in the context of the plan, and in subsequent years (2 and 5) the effectiveness of the plan itself. This assessment will bring together the more program-specific assessments called for in Actions 3A1, 3B1, 4A2, 4B1, 5A1-3, 6A1, 7A1 and 7C1. The Implementation Panel will make recommendations to CAAIST and AISWG. The CAAIST or AISWG will forward the recommendations to the executive managers, the Biodiversity Council, the Ocean Protection Council, and the AIS or Invasive Species Council (if formed).

1A11. Coordinate state AIS management activities with the State Water Resources Control Board (SWRCB) and the Regional Water Quality (RWQCBs) Control Boards.

(CAAIST, SWRCB, RWQCBs) Year 2

Discussion: AIS often exacerbate or complicate pollution control and water quality management. State AIS management activities should be coordinated, through CAAIST, SWRCB and RWQCBs, with state Watershed and Basin Plans, TMDLs for water bodies on the 303 (d) list, and the NPDES permitting process.

1A12. Develop and annually or biennially update a list of AIS experts in California.

(CAAIST, Science Advisory Panel) Year 1

Discussion: The federal ANSTF, USGS, USFWS and NOAA are currently working on developing a list of experts. State agencies should collaborate with the federal agencies on developing and updating the list and making it available to AIS resource managers. Experts are needed in taxonomy, vector management, eradication techniques and ecological impacts.

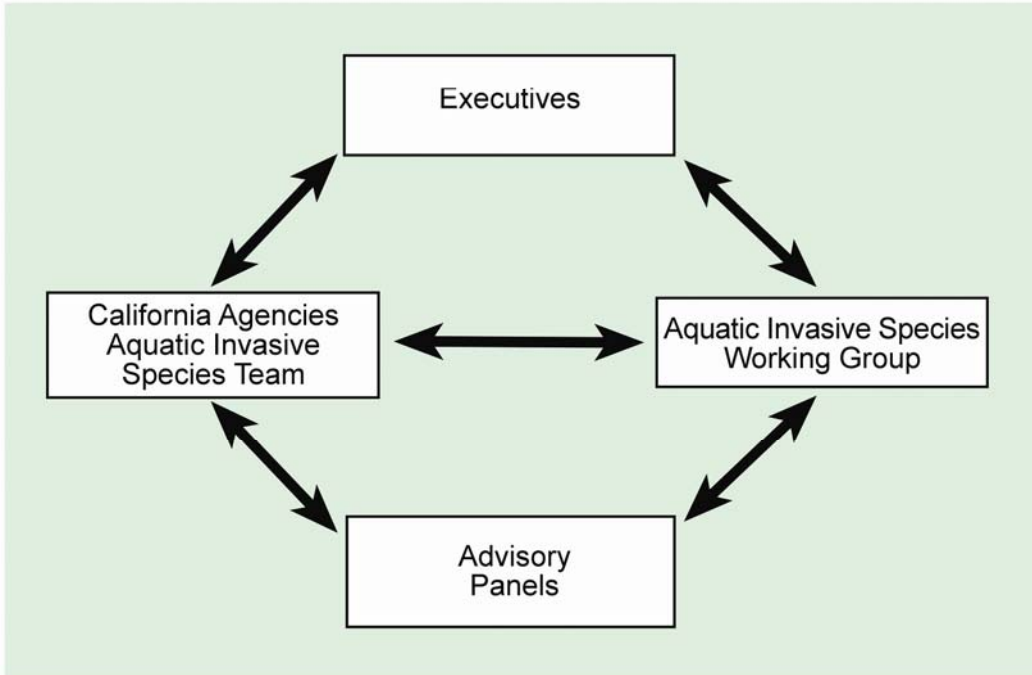
1A13: Develop boilerplate AIS language for agency comments on project plans and other activities.

(CAAIST) Year 2

Discussion: Boilerplate language addressing the need to prevent AIS introduction, or control AIS spread, should be available to agencies commenting on environmental documents, landscape plans, restoration plans and research proposals. Such language should be distributed to all appropriate state, federal and local agency staff.

Figure 5: AIS Coordinating Structure

This figure illustrates the flow of communication about coordination on AIS work. The entities in each box are defined below. As is evident from the definitions, this diagram emphasizes state agency participation. That is because the state has major responsibilities with regard to AIS, and because a primary purpose of the California Aquatic Invasive Species Management Plan is to provide information and guidance to state agencies. It is not meant to diminish the importance of the state's partners in dealing with this issue.



Definitions:

Executives – Representatives of upper level management of state agencies being reported to individually or as a group organized to address invasive species concerns.

California Agencies Aquatic Invasive Species Team (CAAIST) – Representatives from programs in state agencies that meet to coordinate their work on AIS.

Aquatic Invasive Species Working Group (AISWG) - Representatives from state and federal agencies, NGOs, stakeholder groups and research institutions that meet to coordinate efforts among the larger AIS community.

Advisory Panels – Panels that may include people both within and outside of the CAAIST and the AISWG, to help address specific issues or tasks being worked on by those groups.

STRATEGY 1B: LOCAL, NATIONAL & INTERNATIONAL COORDINATION

Continue and improve collaboration among local, regional, state and federal agencies addressing AIS issues; communication with non-governmental organizations, community groups and business interests affected by AIS management; and participation in local, national and international AIS task forces and conferences.

1B1. Identify AIS representatives within key regional agencies, federal agencies and NGOs and provide this information to state managers.

(CAAIST, RI, FA, NGOs, SH) Year 1

Discussion: This action should be completed in collaboration with regional agencies, federal agencies and NGOs. The resulting information should then be posted or distributed to facilitate greater federal, state and local coordination and to provide a springboard for 1B2.

1B2. Identify conflicts and overlaps between state programs and local and federal programs, and between state programs and NGOs, if any.

(CAAIST, RI, FA, NGOs, SH) Year 1

Discussion: This task should be completed in collaboration with regional and federal agencies, NGOs and local watershed management groups. Any significant conflicts and overlaps should be brought to the attention of agency executives and department managers.

1B3. Invite community groups (Native American organizations and industry, business, professional and other groups impacted by AIS management efforts) to participate in planning activities, and to learn more about their role in AIS introduction and dispersal.

(AISWG, SH) Year 2 and Ongoing

1B4. Continue and expand participation in localized efforts and task forces focusing on AIS issues.

(AISWG) Ongoing

Discussion: Participation should extend to the Southern California Caulerpa Action Team, the Lower Colorado River Giant Salvinia Task Force, Team Arundo, and the CALFED Bay-Delta Authority Non-native Invasive Species Program, among others (see Appendix D).

1B5. Continue and expand participation in regional, national and international efforts and task forces focusing on AIS issues.

(AE, CAAIST, RI) Ongoing

Discussion: Participation should extend to the federal ANSTF, the Western Regional Panel, federal ballast water and hull fouling activities, the Pacific Ballast Water Group, the Pacific States Marine Fisheries Commission, the Global Invasive Species Programme, the Invasive Species Advisory Council, the 100th Meridian Project, among others (see also Appendix D).

1B6. Form partnerships with Mexico, Canada, Oregon, Washington, Nevada, Arizona and Colorado River states and secure their input and assistance with AIS issues affecting the Pacific Coast.

(AE, RI, AISWG) Ongoing

1B7. Participate in national and international conferences concerning the management and control of AIS.

(AE, CAAIST, RI) Ongoing

Discussion: AIS conferences increase knowledge of efforts and successes elsewhere, as well as ensure out-of-state awareness of California's issues and activities. Authorization for key out-of-state and out-of-country travel should be promoted.

STRATEGY 1C: FUNDING

Increase funding sources for AIS management and obtain dedicated long-term funding to implement AIS Management Plan tasks and provide matching funds for federal grants.

1C1. Identify and apply for grant funding available in California and nationally.

(CAAIST, RI, NGOs) Year 1-5

Discussion: The federal Nonindigenous Aquatic Nuisance Prevention and Control Act enables state governors to request federal assistance for up to 75 percent of the cost incurred to implement state aquatic invasive species management plans. Currently, the USFWS has a limited budget for grants for this purpose. California should also identify other federal programs that can be used to address invasive species issues (Coastal Zone Management Act etc.), pursue diverse sources of state funding (State Bonds, Sea Grant, etc.) and NGO support (conservation organizations etc.).

1C2. Establish stable, long-term funding to assist in the implementation of the AIS management activities identified in this plan.

(AE, CAAIST) Year 1-3

Discussion: This action should be coordinated with the identification of gaps in 1A10 and 1B2.

1C3. Provide state funding for the AIS positions as detailed in Action 1A8.

(AE, CAAIST) Year 1

Discussion: As noted in 1A8, significant funding has already been allocated.

1C4. Provide funding for AIS rapid response actions when warranted.

(AE) Year 1

Discussion: In Year 1, the Governor approved the expenditure of money for the Quagga Mussel Incident Command. The state's proposed rapid response programs, and some funding issues, are described under Strategy 4A and in Appendix A.

1C5. Finance the hiring of a funding development specialist.

(AE, CAAIST) Year 2

Discussion: Hiring a specialist for 2-3 years to explore and develop funding sources would free up the AIS coordinator to focus on establishing the program necessary to carry out the plan.

1C6. Provide a mechanism to obtain funding to implement additional tasks referred to in this AIS Management Plan, including education, control, monitoring and research.

(AISWG) Years 2-5

Discussion: This mechanism could draw on user fees, visitor taxes, general funds, etc., and build on participation from industries that contribute to, and/or are impacted by, AIS.

The Case for Permanent Funding

Dedicated permanent funding to support permanent staff and agency programs will be a key to effectively addressing AIS issues in California. Though many AIS activities are currently underway throughout the state, almost all of these are operating on 'soft' (short-term/grant) money – a very inefficient approach in the long-term because so much time and effort must be spent soliciting grants rather than managing invasive species. Such grants also result in high staff turnover (including short-term hiring and rehiring); the need to write various status reports to comply with grant requirements; and gaps in eradication and control efforts between funding opportunities, allowing for the recovery of AIS. Thus while soft monies can be very effective for short-term projects such as research studies, they may compromise long-term program operations. There is a clear need for dedicated permanent funding to address aquatic invasive species issues in California.

OBJECTIVE 2: PREVENTION

Minimize and prevent the introduction and spread of AIS into and throughout California waters.

Prevention is the most cost effective and environmentally sensitive method of managing AIS. Prevention revolves around the interception of AIS at the point of entry or release. The movement of AIS into and within California not only takes place via transoceanic ships, but also via other vectors such as aquaculture, the aquarium trade, the bait industry, recreational activities, biological research, environmental restoration projects, and even freshwater diversions to farms and cities up and down the state. California management occurs on both the species and vector level. The actions suggested below seek to: identify high priority vectors and improve programs aimed at addressing them; strengthen enforcement and inspection at entry points; and sustain and expand the state's current ballast water management program and proposed hull-fouling control program. Prevention is a central focus of this plan and it is expected that universities, research institutions and stakeholder groups will be integrally involved in state activities. In addition, prevention efforts targeted at specific vectors will be coordinated with broader outreach and education efforts described under Objective 6.

STRATEGY 2A: REGIONAL VECTOR ASSESSMENT

Identify possible vectors and pathways of AIS introductions into and throughout California and assess the risks and impacts of each.

ACTIONS

2A1. Develop comprehensive regional vector assessments to rank the importance of different AIS vectors in different regions of California.

(RI, DFG) Year 3

Discussion: Some of the vectors California must manage are described in the "Pathways Report" developed by the Aquatic Nuisance Species Task Force and National Invasive Species Council (National Invasive Species Council 2005). The report not only provides a comprehensive vector list, but also criteria for ranking their importance. The information in this report will be used as a foundation for California's regional vector assessment. Comprehensive analysis of vectors in California have occurred for noxious weeds and in areas potentially impacted by ballast water discharges. DFG/OSPR conducts the biological surveys in port/harbor areas and in open coastal areas as directed by the Marine Invasive Species Act. The results of the biological surveys are analyzed for possible vectors of introduction so that high risk vectors can be identified and targeted by prevention programs. Surveys and assessments should be extended to include all waters of the state (i.e. lakes, rivers and streams) so that all potential high risk vectors can be identified. Once a high risk vector is

identified, a detailed assessment of that specific vector is usually needed to quantify the risks and identify potential management options.

STRATEGY 2B: COMMERCIAL VESSELS & MARITIME ACTIVITIES

Reduce the introduction and transfer of marine AIS via ballast water, ballast sediment and hull fouling from commercial vessels and maritime structures.

2B1. Quantify the ballast water and hull fouling vectors, and assess the risk of introduction and dispersal of AIS throughout California from these vectors.

(SLC, RI) Ongoing

Discussion: In 2000, SLC began collecting ballast water report forms from all vessels coming into California from outside the U.S. EEZ. These reports include information about port of origin, how the ballast water was managed (e.g. open ocean exchange) and how much ballast water was discharged. In 2004, SLC expanded their program to require ballast water reports from all vessels, regardless of the last port of call. This comprehensive reporting program is essential to help quantify the extent of the ballast water problem and how it may change over time due to changes in trade routes and/or ballast water management requirements. In addition, in April 2006, SLC approved the following report: “Commercial Vessel Fouling in California: Analysis, Evaluation and Recommendations to Reduce Nonindigenous Species Release from the Non-Ballast Water Vector” (Takata et al. 2006). This report includes recommendations on how commercial vessel fouling should be managed. The recommendations in this report should be adopted. See also Chapter 3.

2B2. Continue to implement and improve California’s current ballast water inspection and enforcement program.

(SLC) Ongoing

Discussion: SLC should continue current ballast water inspection and enforcement program. Training for inspectors should be evaluated and updated as necessary. Technologies such as the handheld Ballast Exchange Assurance Meter, now being developed and tested by the USCG, may prove useful to California’s programs.

2B3. Implement performance standards for the discharge of treated ballast water.

(SLC) Ongoing

Discussion: In January 2006, the SLC approved the report titled “California State Lands Commission Report on Performance Standards for Ballast Water Discharges in California Water” (Falkner et al. 2006). This

report includes interim performance standards, an implementation schedule, final discharge standards and other programmatic recommendations. The report was forwarded to the California Legislature on January 30, 2006 for consideration. In September 2006, legislation based on the report, Senate Bill 497, became law and requires SLC to adopt the interim standards and implementation schedule outlined in the report. Regulations now need to be created and implemented based on the new legislation.

2B4. Identify and address gaps in the Marine Invasive Species Program not addressed by either federal or state law.

(AISWG, SLC, DFG) Ongoing

Discussion: The 2003 Marine Invasive Species Act charged SLC with oversight of the state's program to prevent nonindigenous species introductions through commercial shipping. In recognition of the uncertainties surrounding the development of an effective ballast water management program for the state, the law requires that on or before January 2005, and updated biennially, SLC submit to the legislature and make available to the public, a report that summarizes vessel ballast water activities as they relate to the act and put forward recommendations to improve the state's program. Likewise, DFG is charged with oversight of studies to determine the location and geographic range of AIS in California estuaries and coastal areas and to assess the effectiveness of the ballast water controls implemented pursuant to the law. DFG reports their study results to the public annually.

2B5. Develop a commercial vessel fouling outreach and management program based on results from action 2B1.

(SLC, Sea Grant) Year 1

Discussion: The recommendations of the fouling report described under 2B1 should be adopted and implemented. Options for resolving policy conflicts between efforts to control hull fouling with copper-based anti-fouling paints and efforts to protect water quality need to be explored. Such a resolution may also benefit the implementation of actions related to recreational boats under Strategy 2C.

2B6. Investigate the degree to which moving maritime industry structures, such as oil drilling platforms and barges, may contribute to AIS dispersal.

(DFG, SLC, RI, FA) Year 3

2B7. Quantify and assess the role of commercial fishing vessels as AIS vectors and identify potential management options.

(DFG, RI, NGOs, SH, FA) Year 1

2B8. Develop commercial fishing outreach and management program based on results from action 2B7.

(DFG, AISWG, FA) Year 2

STRATEGY 2C: RECREATION

Limit new AIS introductions through recreational boating, fishing, diving and other water-based activities.

2C1. Quantify and assess the role of recreational boating as an AIS vector and identify potential management options.

(DBW, DFG, RI, SH) Year 1

Discussion: The assessment should examine both the movement of boats over land (trailer boats) and the movement of boats in the water. The assessments should make use of existing data from border protection stations (DFA) and boater surveys (DBW and 100th Meridian Initiative); determine patterns and frequency of watercraft use and transport routes between waterways; and link boater survey results to hull fouling studies (amount of fouling, type of antifouling paint, etc). Information derived from DBW's Boating Facility Needs Assessment may also prove useful.

2C2. Develop a comprehensive recreational boating outreach and management program based on results from action 2C1.

(DBW, UCCE, Sea Grant) Year 2

2C3. Develop a watercraft inspection program for high priority boat launch sites.

(DBW, DFG, DPR, SH) Year 1

Discussion: Unless new funding for agency staff is provided, such a program may need to be volunteer- or NGO-based, or undertaken by a citizen monitoring network as described in 3A5.

2C4. Quantify and assess the role of recreational fishing as an AIS vector and identify potential management options.

(DFG, DBW, RI, SH) Year 3

2C5. Develop a recreational fishing outreach and management program based on results from action 2C4.

(DFG, UCCE, Sea Grant) Year 3

2C6. Develop and distribute guidelines for: disposal of invasive species removed from marina areas (including from hull cleaning); the cleaning of fishing gear and equipment; and disposal of bait.

(DFG, DBW, Sea Grant) Ongoing

Discussion: Collecting fouling organisms removed from larger vessels that are kept in the water poses significant infrastructure and economic challenges that this plan's commitment to statewide collaboration can help address (hauling boats for hull cleaning is nine times more expensive than in-water cleaning). In terms of fishing, contaminated recreational fishing gear and waders function as mechanisms for the introduction and dispersal of AIS throughout California. The angling community is particularly interested in curbing the dispersal of AIS. DFG and DBW will continue to work closely with these stakeholders to identify and publicize methods to decontaminate equipment.

STRATEGY 2D: BAIT, LIVE SEAFOOD, AQUACULTURE & AQUARIUM

Work with appropriate industry representatives to ensure awareness of the threats and prevent introductions.

Discussion: The definition of aquarium may include hobby aquarists, public aquaria (such as Monterey Bay Aquarium) and research aquaria (such as UC Davis Bodega Marine Lab)

2D1. Quantify and assess the role of bait as an AIS vector and identify potential management options.

(DFG, RI) Year 1

2D2. Work with the bait industry to develop preventative strategies, identify education needs and implement permitting of bait imports, collection and sales.

(DFG, UCCE, SH) Year 2

Discussion: Guidelines need to be developed on the use of packing materials for live bait transport. An implementation plan needs to be developed to facilitate permitting bait imports. Input from pathologists is needed to develop prevention strategies and the management program referred to in action 2D3.

2D3. Develop a bait outreach and management program based on results from actions 2D1 and 2D2.

(DFG, UCCE, SH) Year 3

2D4. Quantify and assess the role of live imported seafood as an AIS vector and identify potential management options.

(DFG, DFA) Year 1

2D5. Work with the live imported seafood industry to develop preventative strategies and identify education needs.

(DFG, DFA, UCCE, Sea Grant) Year 2

Discussion: Guidelines need to be developed for use of plants and other live packing materials for seafood transport and linked to education and outreach efforts under Objective 6. Input from pathologists is needed to develop prevention strategies and the management program referred to in action 2D6.

2D6. Develop a live imported seafood outreach and management program based on results from actions 2D4 and 2D5.

(DFG, DFA, UCCE, Sea Grant) Year 3

2D7. Perform an inventory and associated risk assessment of the discharge, overflow systems and storm/flood containment systems of aquaculture, public aquariums and research facilities to determine the potential risks of effluents and propose remedies for remediation and monitoring requirements.

(SWRCB, DFG, RI, SH) Year 3

Discussion: The level of risk currently posed by these facilities is not known and must be more accurately assessed. Though containment procedures must be outlined in the permit process of such facilities, follow-up has been inadequate to ensure procedures and systems are in place and effective. Methods already exist to evaluate the risks associated with this pathway such as those presented in the Aquatic Nuisance Species Hazard Analysis Critical Control Point (ANS-HACCP) planning process. USFWS has adopted ANS-HACCP as a national tool for use by federal fish hatcheries and developed guidance materials and training to facilitate its use.

2D8. Work with the aquaculture industry to ensure understanding of the importance of containment systems as well as the threat escapees may pose to native species and habitats.

(DFG, SH, UCCE) Year 2

Discussion: DFG should provide ANS-HACCP training and assist in development of ANS-HACCP plans.

2D9. Develop an aquaculture outreach and management program based on results from actions 2D7 and 2D8.

(DFG, UCCE) Year 4

2D10. Quantify and assess the ways the aquarium and aquascaping (water garden) trades contribute to AIS introductions in addition to the discharge issue addressed in 2D7 and evaluate potential management options.

(DFG, DFA, RI) Year 1

2D11. Work with aquarium, water garden, and other target industries to ensure that there are easily accessible, appropriate locations and methods for disposal of aquatic organisms.

(DFA, DFG, UCCE, FA) Year 1

2D12. Implement an aquarium and aquascaping outreach and management program based on results from action 2D10.

(DFA, DFG, UCCE, FA) Year 2

STRATEGY 2E: FISHERIES ENHANCEMENT

Assess and minimize activities related to planned, authorized introduction of non-native species into inland water systems.

2E1. Quantify and assess the role of fisheries enhancement as an AIS vector and identify potential management options.

(DFG, RI) Year 1-3

2E2. Review DFG's authorized practice of intentional introductions of non-native species into aquatic habitats for recreational purposes.

(DFG, RI) Year 1-3

Discussion: DFG is currently writing an Environmental Impact Report (EIR) that will examine DFG operated hatchery stocking throughout the State. The anticipated completion date is December 2008.

2E3. Explore ways to reduce the amount of unauthorized stocking of non-native species into aquatic habitats.

(DFG) Year 2

2E4. Assess the efficacy of, versus threats from, authorized introductions of *Poeciliids* into native habitats for mosquito control.

(DFG, RI) Year 2

Discussion: The practice of stocking streams, ditches and other inland waterways with *Poeciliids* (i.e. mosquitofish) to control mosquitoes should be evaluated. Though mosquito control to address human health concerns is certainly important, *Poeciliids* may not be the most effective method, harbor parasites and can be harmful to native insect and fish species.

STRATEGY 2F: RESEARCH, MANAGEMENT & EDUCATION

Minimize AIS introductions and transfers by researchers, resource managers and others involved in field activities.

2F1. Quantify and assess the role of research, resource management and educational activities as AIS vectors and identify potential management options.

(AISWG) Year 2

2F2. Establish and make available protocols to minimize the spread of AIS into the wild from research, monitoring and control activities, and incorporate protocols into permits and funding requests.

(DFG, AISWG, RI) Year 3

Discussion: With the rise in AIS work suggested by this plan, there will be a corresponding increase in the chance of transferring AIS during research or management activities. Protocols addressing this task have been developed by the ANSTF and could be adapted to meet the state's needs. Such protocols should be a standard component of all field activities that involve AIS or infested waters, as well as a required component of AIS grant proposals. Other protocols already exist such as those presented in the ANS-HACCP planning process.

- 2F3. Evaluate existing, or establish new, regulations and protocols for in-water (non-lab) based research experiments that could potentially introduce or involve the culture or movement of non-native species into areas where they do not currently exist.**

(DFG, SWRCB, RI) Year 4

Discussion: Information on gaps in existing protocols and any new protocols developed under this action should be distributed to researchers in coordination with 6C1 and 6C2. Researchers also need to understand that these activities are regulated by Private Stocking Permits. In addition, permit evaluation should include scrutiny of potential AIS issues.

- 2F4. Quantify and assess the role of the shipment of live aquatic species for use in research or educational activities as an AIS vector.**

(DFG, RI) Year 4

Discussion: Marine and freshwater species can be ordered from research and educational supply companies around the world through catalogs or the Internet. Once the organisms are delivered, improper handling techniques may result in the release of non-native species.

STRATEGY 2G: CONSTRUCTION & RESTORATION

Limit new introductions of AIS as a result of restoration, landscaping and construction activities.

- 2G1. Quantify and assess the role of construction activities as an AIS vector and identify potential management options.**

(DFG, RI) Year 3

- 2G2. Work with industry and consultants to develop guidelines for decontamination of construction equipment, tools and protective clothing.**

(DFG, SLC, DPR, FA) Year 2-3

- 2G3. Develop a construction outreach and management program based on results from actions 2G1 AND 2G2.**

(DFG, SLC, DPR, FA, UCCE) Year 4

- 2G4. Quantify and assess the role of restoration activities as an AIS vector and identify potential management options.**

(AISWG, RI) Year 2

Discussion: Construction equipment used for restoration work, as well as soil from nurseries and dredged material used for restoration, can be vectors for AIS.

2G5. Work with consultants and other groups conducting habitat restoration projects or landscaping projects to encourage the use of native species (with propagules from appropriately local stock) or noninvasive non-native species to minimize the transfer of AIS.

(DFG, SCC, AISWG) Year 2-3

Discussion: Non-native species should not be used in habitat restoration and mitigation projects. Approved mitigation and restoration projects should include a program for periodic site monitoring for non-native species and a program for control and, if appropriate and feasible, eradication if an introduction occurs. The use of non-native plant species in public access landscape improvements should be avoided where a potential exists for non-native plants to spread into waterbodies or transition zones between tidal and upland habitats.

2G6. Develop a restoration outreach and management program based on results from actions 2G4 and 2G5.

(AISWG, UCCE) Year 3

STRATEGY 2H: WATER DELIVERY & DIVERSION SYSTEM

Limit new introductions of AIS as a result of water delivery systems.

2H1. Quantify and assess the role of the water delivery and diversion system as an AIS vector and identify potential management options.

(DWR) Year 2

Discussion: The state's extensive water delivery, export, transfer and development system, which moves water not only from one watershed to another, but also from one end of the state to another, and even across state lines, can be an important vector of AIS. Water deliveries can spread freshwater-adapted AIS within and out of state, and carry species from infested areas to more pristine locales. Intensive manipulation of natural water paths and flows in support of these water diversions and deliveries, and of the aquatic ecosystem in general, makes California particularly vulnerable to AIS. Not only can AIS be more easily transferred via all these diversions, but they may also find it easier to colonize areas where native species are already stressed by the loss of habitat caused by dams, water diversion, altered hydrology and development.

2H2. Develop an outreach and management program for the water delivery and diversion system based on results from actions 2H1.

(DWR, UCCE, Sea Grant) Year 3

STRATEGY 2I: ENFORCEMENT & INSPECTION

Increase enforcement of existing regulations controlling the transport, propagation, sale, collection, possession, importation, purchase, cultivation, distribution and introduction of AIS.

Discussion: State resources directed toward interdiction and inspections at major points of entry for invasive species are inadequate. This plan seeks to improve inspections at both interior and coastal borders and increase monitoring efforts to ensure compliance with current regulations.

2I1. Increase staffing and hours of operation at DFA Border Protection Stations.

(DFA, SH) Year 1

Discussion: DFA operates 16 border protection stations (BPS) on major highways entering California. When BPS stations perform boat inspections, they remove any quagga or zebra mussels found on infested boats, place the boat under quarantine and coordinate with DFG personnel to supervise final cleaning at destination points. Before 2003, DFA inspectors checked all watercraft entering California through these stations for AIS, including zebra mussel and *Hydrilla*. However, in 2003, the program was subject to severe budget cuts and the ability to inspect small, privately transported watercraft was lost. At 15 of the 16 BPS, only watercraft transported by commercial vehicles were inspected from 2003 through the end of 2006. At the end of December, 2006, only nine of the stations were open 24/7, while the other seven were open only eight hours a day. DFA suggests that in order to prevent AIS invasions, all boats should be inspected, all check stations should be open 24 hours a day and all staff (and the CHP) should be trained in zebra mussel, quagga mussel, aquatic weed and other AIS identification, disposal and reporting to other state agencies. The recent quagga mussel discovery in January 2007 in Lake Mead allowed state agencies to get funds to increase staffing in southern California. Additional funding and staff are needed to reopen all stations and inspect private vehicles.

2I2. Develop and distribute comprehensive guidelines for border inspections of boats, boat trailers and water-based equipment entering California.

(DFA, DFG) Year 1

- 213. Increase DFG staffing to more effectively enforce current regulations on prohibited and restricted species, and on movement of aquatic species.**

(DFG, SH) Year 1-2

Discussion: Various regulations exist to protect valuable resources against the introduction of prohibited and restricted species. In Year 1, the Governor approved additional staffing for enforcement laws related to quarantine of vessels infested with prohibited species.

- 214. Ensure adequate staffing and clear cargo inspection guidelines for inspectors and enforcement officers at maritime ports and at airports.**

(FA, AISWG, SLC) Year 3-5

Discussion: Inspecting cargo is a critical step in preventing unwanted species from entering the state. Adequate staffing and clear guidelines are needed for inspectors to be effective. Close coordination and collaboration with federal inspectors (including USCG, USFWS, USDA, and DHS) will be required. Training for inspectors should be evaluated and updated as necessary.

- 215. Continue disease sampling for shipments and stocks of live fish and other species. Assess whether current systems are adequate to keep contaminated stocks from being distributed via aquaculture, the aquarium and bait trade, terminal food markets, research activities and government stocking programs.**

(DFG) Ongoing

- 216. Develop a program to identify mail order and online vendors who are selling California prohibited and restricted species, and work with these vendors to keep AIS from being imported into the state.**

(AISWG, RI) Year 2

Discussion: There are multiple cases of restricted and prohibited stocks being sold without detection by government regulators, not only in local venues, but also through mail order or from on-line sources. Any California enforcement should integrate with efforts such as USDA's current development of a WebCrawler designed to identify online vendors of federally listed noxious weeds and regulated plant species.

OBJECTIVE 3: EARLY DETECTION & MONITORING

Develop and maintain programs that ensure the early detection of new AIS and the monitoring of existing AIS.

Early detection of introductions and quick, coordinated responses can eradicate or contain invasive species at much lower cost than long-term control. In many cases, control may not only be prohibitively expensive but also infeasible. Thus detection of non-native arrivals, before they become established, should be a priority for any AIS management effort. The purpose of this section is to acknowledge the importance of continuing current monitoring programs and to identify gaps and areas for improvement. Significant improvements will clearly come from coordination at multiple levels in both planning and implementation. As such, some of the following actions aim to better link the many different natural resource and AIS monitoring programs conducted by diverse agencies and academic institutions to improve AIS detection. Actions also seek to better integrate Geographic Information System (GIS) mapping into AIS management, and to make state databases more compatible with, and responsive to, AIS management needs. Actions under Objective 3 should be coordinated with research efforts under Objective 7 and with priority lists developed under 1A6.

STRATEGY 3A: *EARLY DETECTION*

Develop a standardized monitoring system focused on early detection for high priority AIS.

ACTIONS

3A1. Assess all current monitoring of the state's coastal, marine and inland waters for opportunities to incorporate early detection of AIS.

(CAAIST, RI, CeNCOOS, SCCOOS) Year 1

Discussion: High priority AIS for early detection may include zebra mussel, quagga mussel, Northern Pacific seastar, snakehead, *Caulerpa*, *Hydrilla*, *Salvinia*, golden mussel and others. A more complete and up-to-date list for use in any assessment will be developed under Action 1A6.

3A2. Assess how current monitoring under the state's Marine Invasive Species Program could assist with early detection.

(SLC, DFG, RI) Ongoing

3A3. Develop a statewide integrated approach to early detection based on the assessment in 3A1 and 3A2. The approach should address any gaps and link directly with the centralized reporting system and rapid response program described in 4A2 and Appendix A.

(CAAIST, AISWG) Year 1

3A4. Conduct outreach to entities regularly sampling coastal, marine and inland waters for other purposes so they can easily identify and report high priority AIS.

(CAAIST, UCCE, Sea Grant) Year 2-3

Discussion: Those already conducting field work or surveys – researchers, graduate students, resource managers, water quality monitors, law enforcement personnel and others – should be encouraged and trained to identify high priority AIS (as defined under 1A6). Special identification materials for high priority AIS should be developed and distributed to support the early detection effort.

3A5. Create and train a statewide citizen monitoring network to assist in the detection and monitoring of AIS distribution.

(CAAIST, UCCE, SH) Year 3

Discussion: Trained volunteers and knowledgeable water users already working near or in the water can provide relevant information on the occurrence of new species. To be effective, this network will need a direct link into an early warning system that incorporates follow-up. Some elements necessary to the development of an effective citizen-monitoring network may include: a structured training program; expansion of current monitoring and restoration programs to better engage community groups; outreach to existing watershed councils, diver associations, flood control districts, reclamation districts and other monitoring efforts; distribution of key species pictures and descriptions (as defined under 1A6); and the creation of a website to allow volunteers and water users to report their AIS sightings (see 4A2).

3A6. Create a program to engage professional divers in the early detection network.

(CAAIST, AISWG, NGOs) Year 1

Discussion: Involve and educate professional divers – who are frequently in the water and under boats cleaning hulls – in AIS detection and management, among them the California Professional Divers Association. Link with 3A5 and with appropriate educational and outreach activities in Objective 6 (such as 6A9 and 6A13).

3A7. Regularly review the efficacy of the state’s AIS early detection monitoring systems and pursue any necessary improvements, in conjunction with 3B7.

(AISWG) Ongoing

Discussion: State AIS staff should review the type, intensity, frequency and distribution of monitoring activities on a regular basis to assess continued relevance and effectiveness. Such a review should occur at a minimum on a biennial basis.

STRATEGY 3B: LONG-TERM MONITORING

Improve and standardize the long term monitoring program for AIS.

3B1. Assess current long-term AIS monitoring efforts for the state’s coastal, marine and inland waters; identify gaps, and recommend improvements for a more integrated approach.

(AISWG, CeNCOOS, SCCOOS, DFG/OSPR) Year 2-3

Discussion: Within the current agency management framework, monitoring occurs, and will continue to occur, on two parallel tracks: DFA monitors specific target species in order to undertake early detection or eradication; DFG/OSPR monitors populations over time, and notes new populations or changes in species abundance. Both types of monitoring are critical to sound management and provide building blocks for a more integrated approach.

3B2. Coordinate with ocean observing groups.

(AISWG, CeNCOOS, SCCOOS) Ongoing

Discussion: Monitoring of invasives in the marine and coastal areas of California should be coordinated with the regional ocean observing systems (SCCOOS-Southern California Coastal Ocean Observing System and CeNCOOS-Central and Northern California Coastal Ocean Observing System).

3B3. Identify and monitor locations with a high invasion rate.

(AISWG, DFG/OSPR, RI) Ongoing

Discussion: High risk locations may include ports, ballast water release sites, popular recreational lakes and marinas near state borders, as well as areas with high density AIS populations.

3B4. Identify and monitor the population growth and dispersal of established AIS.

(AISWG, DFG/OSPR, RI) Ongoing

Discussion: Species-specific monitoring is needed for those species identified as high risk or high priority (see 1A6). Examples of established species that may require monitoring appear in Table 3 and Chapter 8.

3B5. Obtain funding to incorporate DFG's historical stream surveys and report findings into a central database.

(DFG) Year 1

Discussion: These historical surveys document areas where rare or native fish occur, and where incipient populations of AIS could cause extirpation of local fish populations. Funding has been obtained for new surveys of some streams in southern California in 2007.

3B6. Include maps of existing AIS in California's coastal and inland waters in the DFG Biogeographic Information and Observation System (BIOS).

(DFG, DFA) Year 2-5

Discussion: Mapping is an important step in determining the spatial distribution of AIS, and could help with the completion of other early detection and monitoring tasks. BIOS is available to the public and contains user-friendly, Internet-based maps.

3B7. Regularly review the efficacy of the state's AIS long-term detection and monitoring systems, and pursue any necessary improvements, in conjunction with 3A7.

(AISWG) Year 2-5

Discussion: Such a review such should occur at a minimum on a biennial basis.

OBJECTIVE 4: RAPID RESPONSE & ERADICATION

Establish and manage systems for rapid response and eradication.

Once AIS are established, complete eradication is often infeasible. Eradication or containment of pioneering populations is generally much more feasible, making rapid response a key AIS management strategy. Rapid response is facilitated by formal advance agreements between likely participants that address roles, responsibilities and procedures. As such, it requires a pre-planned collaborative effort on the part of government agencies, academic institutions and private interest groups.

STRATEGY 4A: RAPID RESPONSE

Implement a coordinated system for rapid response efforts to contain newly detected AIS.

ACTIONS

4A1. Develop and implement a statewide rapid response plan.

(DFG, AISWG) Year 1

Discussion: The Rapid Response Plan for AIS in California appears in Appendix A. This DRAFT plan was written in accordance with the federal guidelines for rapid response systems (USEPA 2005) and includes concepts presented in DFA's Model Rapid Response Plan for Aquatic Nuisance Species (see bibliography in Appendix A for references). It includes a proposed rapid response procedure that is based on formal interagency agreements. It also includes a planning section that discusses coordination among interested parties, issues that must be addressed to finalize the plan, funding and the need to develop interim rapid response protocols prior to plan completion.

4A2. Evaluate how existing systems for reporting AIS sightings or other natural resource problems (e.g. poaching, pollution discharge, birds infected with West Nile Virus) can either be used directly or as a blueprint for an AIS reporting system in California and coordinate systems as in 3A3.

(CAAIST, AISWG) Year 1

Discussion: Based on the results of this evaluation, utilize an existing system or develop a new system for the public to report AIS sightings. This reporting system needs to feed into the first steps of the rapid response procedure (Appendix A) which requires obtaining a definite identification of the species, determining whether it is a detrimental invasive species and notifying the appropriate authorities. Currently there are a number of options for submitting reports of possible aquatic invasive

species sightings, but focusing outreach efforts on one website/hotline destination may prove more efficient in the future. Current general reporting options include: 1) sending an e-mail to invasives@dfg.ca.gov; 2) submitting a form to the federal Nonindigenous Aquatic Species Program – <http://nas.er.usgs.gov> (click on Alert System); 3) calling their hotline – 1-877-STOP-ANS. The federal system passes information on to DFG and USFWS.

4A3. Develop species- and/or location-specific rapid response plans.

(AISWG) Ongoing

Discussion: A generic plan, described in Task 4A1, is necessary because it is not possible to write a plan for every species or location that may require rapid response to an AIS infestation. Species or location specific rapid response plans can include information that makes them more efficient to implement than a generic plan. The state needs to prioritize which species (using the list developed in 1A6) and locations warrant specific rapid response plans and develop these plans. Models already developed, such as the Non-Native Invasive Pest Intervention Team model (Anderson 2005) may be of value in creating such plans.

4A4. Explore the establishment and administration of permanent funding to implement rapid response plans, in conjunction with 1C4.

(AE, NGOs, SH) Year 2

Discussion: Washington, Massachusetts and other states have established emergency funds reserved for the containment/eradication of pioneering AIS infestations. California lacks emergency funding for immediate species identification and control actions. Without such funding, rapid response may not occur. The Ocean Protection Council's Strategic Plan identifies establishment of such a fund for coastal AIS as a high priority.

STRATEGY 4B: ERADICATION

Eradicate targeted populations of AIS.

4B1. Review and evaluate the effectiveness of eradication programs.

(AISWG) Year 2

Discussion: Eradication programs often compete for limited resources, and sometimes result in conflicts and trade offs among different public mandates. Regular evaluation and discussion among state agencies and the AISWG, with major conflicts brought to the attention of agency executives, will help streamline state eradication efforts. Findings and recommendations from research on the economic benefits and efficacy of

various management and prevention approaches developed under Actions 7B1-2 and 7C1-2 and 7C4 would be incorporated in the review.

4B2. Continue and complete effective current eradication efforts, in coordination with 4B1 and conduct follow-up monitoring to ensure eradication.

(AISWG) Ongoing

Discussion: As of fall 2006, recent or ongoing eradication programs within the state of California included, but were not limited to, *Hydrilla*, giant salvinia, smooth cordgrass, *Arundo*, alligatorweed, Japanese eelgrass and Northern pike. More information on some of these eradication efforts and species appears in Chapters 2, 4 and 8.

4B3. Standardize and apply sets of criteria that can be used to identify priority species for eradication under rapid response scenarios or more long-term efforts.

(CAAIST, RI, Science Advisory Panel) Year 1-2

Discussion: It would be helpful establish criteria to answer questions such as: Is it feasible and appropriate to attempt to eradicate a particular AIS infestation? Is it worthwhile to attempt a statewide eradication effort for a given species? These criteria would provide tools for DFA and DFG to reconcile their current screening strategies for AIS importation, help streamline decision making during the rapid response process and categorize AIS species into different management classes for planning purposes.

4B4. Develop and implement a method to identify priority sites of AIS invasion concern, in order to better prepare for rapid response and eradication.

(AISWG, Science Advisory Panel) Year 2

4B5. Identify ecologically sensitive waters as targets of additional precautionary protocols.

(AISWG, Science Advisory Panel) Year 2 and Ongoing

Discussion: To the extent possible, existing designations (e.g. National Estuarine Research Reserves, National Marine Sanctuaries, Marine Reserves, Critical Coastal Areas, etc.) should be used to compile locations and maps of ecologically sensitive waters. This action should also be coordinated with BIOS mapping efforts under 3B6.

OBJECTIVE 5: LONG-TERM CONTROL & MANAGEMENT

Control the spread of AIS and minimize their impacts on native habitats and species.

Long-term control and management activities should be focused on populations of established species where there is a clear and significant impact on economically important species, native species, human health, infrastructure, recreation and navigation, and where the control of specific populations is both technically and economically feasible. In many cases, past control efforts occurred as the result of a local management priority such as a weed clogging a favorite fishing spot, swimming hole or creek habitat, and the control measures undertaken by local groups and entities, sometimes with state support. State control programs tend to focus on larger scale impacts (water hyacinth in Delta waterways, for example), or AIS that threaten sensitive species, protected areas or water conveyance systems. As such, some control programs are coordinated among state, regional and local agencies, and some are not. The actions in this objective seek to prioritize control efforts; coordinate state control efforts with local and federal efforts; interface with appropriate researchers; provide technical assistance to local watershed groups, irrigation districts and others undertaking AIS management; and address AIS concerns in habitat restoration planning, landscape construction and maintenance projects.

STRATEGY 5A: CONTROL

Control known AIS populations where economically and technically feasible.

ACTIONS

5A1. Develop a method or criteria to prioritize control actions based on both the threat level and the anticipated efficacy of control actions.

(CAAIST, FA, RI) Year 2

Discussion: Criteria developed under 4B3 may be of some help in this endeavor.

5A2. Prioritize control efforts for all organisms, including new organisms of concern.

(CAAIST, FA, RI) Year 2

Discussion: With limited resources, prioritization of control efforts is a necessary part of addressing AIS issues throughout California. Statewide staff must coordinate priorities with local and regional staff and other agencies. A decision tree should be developed for determining whether to implement a control program, what types of control actions to use and how to accomplish the necessary permitting. Species could be placed in the

species management categories mentioned in Table 3, in coordination with lists developed under 1A6.

5A3. Continue ongoing control programs, following program review and in coordination with 5A1, 5A2 & 5A4.

(DFA, DFG, SCC, FA, RI) Ongoing

Discussion: Agencies can request that one of the AIS technical panels review an ongoing program and provide advice on what future actions should be. In addition, panels and agencies should take into consideration any findings from the Action 5A1 and 5A2 prioritization, the high-priority species lists developed under 1A6 and any findings and recommendations from research on efficacy of various management approaches developed under Objective 7.

5A4. Develop new species- and site-specific control plans as necessary for projects that are implemented by state agencies based on 5A1-3 above and on lessons learned from relevant projects inside and outside California. Coordinate with AISWG regarding plans being developed for entities other than state agencies.

(CAAIST, FA, RI) Year 2

5A5. Provide technical assistance to watershed councils, irrigation districts and other local boards for development of AIS management plans.

(AISWG, UCCE, CACASA, RCD) Year 3-5

STRATEGY 5B: *LIMIT DISPERSAL TO NEW AREAS*

Limit the dispersal of established AIS to new water bodies or to new areas within inland water bodies.

5B1. Establish boat washing stations and disposal facilities at infested water bodies.

(DFG, DBW, DFA, SH) Year 1

5B2. Install warning and information signs in infested areas at local kiosks, boat ramps and on floating buoys to limit the spread of existing AIS by boats, personal watercraft, movement of live fish and bait buckets.

(DBW, DFG, DPR, SH) Year 1

5B3. Use volunteer monitors to conduct AIS inspections at heavily used boat access areas.

(DFG, DBW, NGOs, SH, FA) Year 1

5B4. Develop criteria and a plan for enforcing the temporary or long-term closure of specific areas infested with high priority AIS, as defined in 1A6.

(DFA, DFG, DBW, SH) Year 2

STRATEGY 5C: PROTECT NATIVES

Protect areas of special ecological significance, and state and federally listed rare, threatened and endangered species, from AIS invasions.

5C1. Coordinate among appropriate state, federal and local government agencies, existing relevant coalitions such as the Weed Management Areas and private land management organizations, to prioritize ecologically sensitive areas most at risk due to AIS impacts.

(AISWG) Years 2-5

5C2. Coordinate the entities discussed in 5C1 to meet protection and restoration objectives with respect to AIS.

(AISWG) Years 3-5

5C3. Develop GIS-based maps that show coincidence of AIS and critical ecosystems.

(DFG, DFA, RI, DFG/OSPR) Years 3-5

Discussion: Mapping should be in coordination with other mapping actions under 3B6 and 4B5. These GIS layers will assist in setting priorities for eradication and control projects.

5C4. Establish and disseminate clear guidelines for action when AIS eradication or control efforts will take place in areas of special ecological significance.

(AISWG) Year 2

5C5. Adopt guidelines on best management practices for timber, crop production and livestock activities around water in order to prevent invasions.

(AISWG) Year 2

5C6. Assess any existing guidelines, and where necessary develop new guidelines, for preventing AIS spread through projects involving riparian, wetland and shallow water habitat restoration and/or shoreline landscaping.

(CAAIST) Year 1

Discussion: Newly cleared and created habitats can easily and immediately be colonized by opportunistic invasives. Measures are often necessary to prevent such invasions. Some work to gather existing guidelines for invasive plant species has been conducted by USFWS' Non-Native Invasive Species Program on behalf of the California Interagency Noxious and Invasive Plant Committee (L. McLaughlin, Personal Communication).

OBJECTIVE 6: EDUCATION & OUTREACH

Develop a comprehensive education and outreach program to ensure awareness of AIS threats and management priorities throughout California.

Most people do not recognize the threat that aquatic invasive species pose and how their own actions may lead to new infestations. The strategies and actions listed below are some of the elements that should be included in a comprehensive AIS education and outreach program. For many of these strategies and associated tasks, similar efforts are being undertaken in other states and on an international level. California should link with these existing efforts and use tools and methods proven effective elsewhere. Many outreach efforts and materials are developed outside of state or federal agencies, particularly by University of California and Sea Grant extension programs. Agencies should utilize the expertise and products available as much as possible. These programs should, in turn, seek agency input in product development. In addition to the many general outreach actions described below, several targeted outreach actions are listed under other objectives in this plan (2C6, 2D2-3, 2D5-6, 2D9, 2D12, 2G2-3, 2G5-6, 2H2, 3A4-6, 5B2, 5C1 and 5C5-6).

STRATEGY 6A: OUTREACH

Increase education of, and outreach to, those who may be potential sources for AIS introductions.

ACTIONS

6A1. Inventory existing education and outreach efforts in order to prioritize future strategies and develop a statewide AIS communication strategy.

(CAAIST, UCCE, Sea Grant) Year 2

Discussion: A dedicated effort is needed to inventory diverse existing education and outreach programs so that gaps and overlaps can be addressed and priorities for new programs identified. This effort should be closely coordinated with activities under Objective 2: Prevention.

6A2. Partner with ongoing outreach campaigns.

(CAAIST, UCCE, Sea Grant) Year 1

Discussion: National campaigns now underway include *Habitattitude* (pet industry and pet owner outreach) and *Stop Aquatic Hitchhikers* (boating and recreational outreach). Other state and NGO programs have established AIS outreach efforts and campaigns within California or in specific regions. Future partners for state education efforts may include industry groups, UCCE, Sea Grant and NGO programs. See Appendix D.

6A3. Develop a DFG Communications Plan.

(DFG) Year 2

Discussion: Currently, DFG staff develops brochures, posters, articles and press releases in an ad hoc manner. A communications plan will provide stakeholders and the general public with ongoing coordinated exposure to AIS issues.

6A4. Develop and distribute printed material (posters, brochures and articles) for specific industry sectors and user groups.

(AISWG, UCCE, Sea Grant) Year 1-5

Discussion: Target audiences may include the owners and employees of pet and aquarium stores, nurseries; wholesalers and shippers dealing in aquarium organisms; operators of water-based businesses (such as boat charter operators, marinas, angling guides, fishing tournament organizers, harbor masters, dive shops, seaplane operators, and dredging contractors).

6A5. Develop permanent interpretive displays at appropriate marinas, boat ramps and state fishing access sites.

(AISWG, SH) Year 2-5

Discussion: Educational signage should also be developed for important stream/river crossings on major recreational trails. Non-aquatic outdoor sports that involve aquatic crossings (equestrian trails, hiking and bicycle trails, 4-wheel drive dirt roads) can be targeted through information posted at trailheads and other high use areas.

6A6. Work directly with promoters of industry trade shows to deliver the AIS message.

(DFG, DFA, DBW, SLC, Sea Grant, RI, SH) Ongoing

Discussion: Some initial work done by DFG, DFA, DBW, SLC, Sea Grant, UCCE, and other organizations, can contribute to a comprehensive outreach program.

6A7. Present and distribute AIS information at various conferences, tournaments, fairs and other public gatherings.

(AISWG, Sea Grant, SH) Ongoing

Discussion: The ongoing efforts should reach as many venues as possible and avoid duplication.

6A8. Continue to include information on AIS in state hunting, fishing and boating regulations and licenses.

(DFG, DBW) Ongoing

6A9. Publish information about AIS in fishing and recreational newspapers, magazines, and newsletters.

(DFG, DBW, UCCE, Sea Grant, NGOs) Year 2-5

6A10. Develop AIS identification cards to be distributed to all appropriate audiences.

(AISWG, SH, Sea Grant) Ongoing

6A11. Encourage industries to offer noninvasive alternatives to AIS whenever possible and to educate their consumers about the availability of such alternatives.

(AISWG, SH) Year 3-5

Discussion: To aid with this effort, develop “California-friendly” or “green species” lists for specific user groups and industries.

6A12. Partner with diverse stakeholders and interest groups to multiply education efforts and distribute some of the materials developed in 6A4-6A10.

(AISWG, SH) Ongoing

Discussion: Work can be done, for example, with aquarium, water garden and other target industries to educate consumers, retailers and wholesalers of the importance of preventing the release of unwanted organisms into aquatic systems.

6A13. Educate waterfront and shoreline property owners, including those on lakes, rivers and streams, about AIS.

(DBW, SCC, NGOs, SH) Year 3-5

6A14. Develop and offer AIS management classes for professional organizations.

(AISWG, UCCE, SH) Year 4

Discussion: Training programs are needed for professionals such as pest control applicators, diving instructors, water/irrigation engineers and habitat restoration planners.

- 6A15. Continue state education measures concerning ballast water.**
(SLC, Sea Grant) Ongoing

STRATEGY 6B: POLICYMAKERS

Engage policymakers and legislative staff in AIS policy and outreach efforts.

- 6B1. Provide decision makers and legislators with educational briefings on AIS threats and economic impacts, site visits showcasing impacts and controls and regular updates on AIS management progress.**

(CAAIST, FA, RI, NGOs, SH) Years 1-3

- 6B2. Periodically update the Fish and Game Commission, SLC, OPC, SCC and CCC on invasive species activities.**

(DFG, CAAIST) Years 1-5

STRATEGY 6C: RESOURCE MANAGERS & RESEARCHERS

Increase AIS awareness and support for management within the scientific community and natural resource agency staff.

- 6C1. Increase awareness of AIS among scientific and natural resource management interests.**

(RI, CAAIST, FA, NGOs, SH) Ongoing

Discussion: This effort should promote greater awareness and information-sharing among those working in the field and in resource management projects that may be impacted by AIS. Possible avenues for this networking include: supporting symposia, workshops and conferences (highlighting new findings and activities discussed at local, national and international conferences); developing a centralized AIS communication forum for California (such as a species-specific list serve); and engaging managers and scientists in identifying, monitoring and reporting AIS as described in 3A4. Classes in AIS management (such as those offered by UCCE and Sea Grant) should be offered through public agency training programs, and held in locations resource managers can easily attend, or be offered on-line or in video.

- 6C2. Work with institutions and agencies conducting scientific research to ensure awareness of proper AIS containment and disposal methods, as well as legal restrictions.**

(DFA, DFG, RI) Year 2

Discussion: Such an effort may be coordinated with the interests listed under 3A4.

6C3. Develop an AIS regulatory handbook.

(CAAIST, FA) Year 3

Discussion: The handbook should explain laws, regulations and permitting processes aimed at people that plan or practice various AIS control measures.

6C4. Share and disseminate information on current mechanical, chemical, biological and physical control methods.

(AISWG, SH) Ongoing

6C5. Disseminate guidelines developed in 5C4-6 and promote the use of native plants and/or non-invasive species in restoration, shoreline landscaping, and for timber, agricultural, or livestock activities around waterways.

(CAAIST, UCCE, Sea Grant) Year 2

Discussion: California-friendly species lists developed under 6A11 can be used.

6C6. Encourage the training of more taxonomists.

(AISWG, NGOs, SH, RI) Year 3

Discussion: A lack of professionally trained taxonomists is becoming a bottleneck in early detection efforts. Universities and colleges have significantly cut taxonomist positions and classes in recent years. AISWG and stakeholder groups, with a vested interest in protection from AIS, should address this problem and seek funding for training.

STRATEGY 6D: SCHOOLS

Increase AIS awareness within the educational system.

6D1. Train speakers to give guest presentations on AIS issues at schools, and develop resource packets for them to use when visiting classrooms, in coordination with 6E5.

(AISWG, NGOs, SH) Year 2-5

6D2. Assess existing K-12 environmental education curricula for opportunities to integrate AIS information, and develop new curricula as necessary.

(UCCE, Sea Grant, DOE) Year 3-5

Discussion: AIS related curricula should be integrated into in-service training and continuing education programs for teachers. California may be able to build on existing curricula, and other school and educational materials, developed through Sea Grant programs in other states.

6D3. Further integrate AIS issues into service and education projects that involve students as part of a science class, science club or for community service credit offered at some schools.

(UCCE, Sea Grant, DOE) Year 3-5

6D4. Educate teachers about proper disposal methods for organisms used in the classroom and at science fairs to prevent release or transfer of AIS.

(UCCE, Sea Grant, DOE) Year 2

Discussion: ANSTF protocols for science fairs can be adapted to in-classroom disposals and other education activities.

STRATEGY 6E: GENERAL PUBLIC

Raise awareness, concern and achieve buy-in on AIS issues by all California residents and visitors.

6E1. Develop a press kit and work with the media to ensure the accuracy of any information published.

(DFA, DFG) Year 1

6E2. Increase local television, radio and newspaper media coverage of California's AIS threats and management priorities using the press kit described in 6E1 and other outreach techniques.

(CAAIST, UCCE, Sea Grant, NGOs, RI) Year1

6E3. Identify key state publications and websites to which AIS information can be added.

(CAAIST, UCCE, Sea Grant, NGOs, RI) Ongoing

Discussion: Ensure website links are established so that public information on AIS is easy to find and gets wide exposure. Coordinate with efforts under 1A9.

6E4. Develop multi-cultural educational materials on AIS that can engage California's diverse population.

(UCCE, Sea Grant, AISWG) Year 2-5

6E5. Develop a variety of presentations, including AIS traveling trunks and portable presentation boards, for use in both public and private venues, and train presenters.

(UCCE, Sea Grant, AISWG) Year 1

Discussion: Venues might include state parks, schools, libraries, natural history museums, aquariums, coastal access points and other recreational facilities.

OBJECTIVE 7: RESEARCH

Increase research on the baseline biology of AIS, the ecological and economic impacts of invasions, and options for control to improve management.

Increased knowledge of the biology of invasive species and associated control methods will improve AIS management. The state would benefit from the development of a comprehensive research agenda that sets priorities and guides researchers towards important topics. Such important topics include: quantifying and clarifying the effects of non-native species on native plants and animals and their habitats; examining economic effects of AIS; pinpointing any human health and safety concerns resulting from infestations; and exploring improved methods of restoring invaded habitats to their native condition, during and after the effective management of AIS. Partnerships with universities, research institutes, consulting firms and others conducting such research are necessary so that agencies can develop their management programs with scientific input. In addition, given the plethora of organizations involved in AIS issues in California, it is important that any available research funds are allocated competitively, based on a research group's specialized ability. Actions under Objective 7 should be coordinated with monitoring efforts under Objective 3.

STRATEGY 7A: BASELINE BIOLOGY

Increase our knowledge about AIS in order to develop effective prevention, control and management programs.

Discussion: Management must be based on solid scientific information on AIS population dynamics, reproductive biology and ecological conditions fostering growth. Many of these factors are not yet fully understood for both the AIS that are already in California and the AIS that are at high risk of being introduced in the foreseeable future.

ACTIONS

7A1. Host workshops to develop AIS research priorities and identify research gaps.

(RI, AISWG) Ongoing

Discussion: In 2005, two research priority workshops were held, one that addressed freshwater invasive plants and another that looked at invasive seaweed research needs.

7A2. Baseline biological studies on AIS and biological invasions should continue in coordination with 7A1 and 7C4.

(RI, AISWG) Ongoing

7A3. Develop a strategy to communicate and support research needs.

(AISWG, RI) Year 3

Discussion: Research needs could be communicated to the scientific community and institutions that support research in several ways: through networking among existing or new interagency committees, through a new research center that deals specifically with AIS or, through an existing center with an AIS component or emphasis.

STRATEGY 7B: ECONOMICS

Increase knowledge of economic impacts of AIS.

7B1. Perform economic impact studies on the effects of AIS on California, including costs and benefits of vector prevention.

(CAAIST, RI) Year 1

Discussion: A small number of studies around the world have begun to document the economic impacts of AIS but California-specific studies are needed. In many cases, economic impacts will be the driving force for change in personal and business actions, management and policy. Prevention is often more cost-effective than control when addressing AIS concerns. Economic analysis can help determine priorities for use of limited funds. Results of these studies should be communicated to those responsible for 4B1-2, and 5A1-3, and 6A1.

7B2. Conduct an economic assessment of different AIS management techniques, in support of Strategy 7C.

(RI, AISWG) Year 2

STRATEGY 7C: MANAGEMENT OPTIONS

Research current and potential management alternatives and determine their efficacy in controlling invasions and their effects on native species.

7C1. Evaluate and research current AIS management methods to improve their efficacy, safety and efficiency.

(AISWG, RI) Ongoing

Discussion: This should include a review of public health and environmental risks associated with various management options so that decision makers can take those constraints into account and be better prepared to answer inquiries about any risks. Results of these studies should be communicated to those responsible for Actions 4B1-2, and 5A1-3, and 6A1.

7C2. Investigate the efficacy of invasion prevention techniques.

(AISWG, RI) Year 2

Discussion: Different prevention techniques need to be investigated in terms of their efficacy in achieving the goals of this plan. For example, antifouling techniques available for larger ships are often inappropriate for smaller recreational boats and boats that travel different routes. Anti-fouling techniques need to be examined, compared and tested, as one method is unlikely to work in all instances. Results of these studies should be communicated to those responsible for developing prevention programs under Objective 2.

7C3. Consider the establishment of a testing and evaluation center for shipboard ballast water treatment technology.

(SLC) Year 1 and Ongoing

Discussion: The existing state program does not have the expertise, equipment, facilities or financial resources necessary for the testing and certification of treatment technologies for discharged ballast water. A new center would substantially improve the implementation of performance standards and the ongoing evaluation of technologies once approved. USCG and Naval Research Labs have recently established a testing and evaluation center in Key West, Florida; however, this single facility will only be able to consider three or four systems annually, once testing and verification protocols are established. Discussions between SLC staff and USCG have identified the need for additional testing and evaluation centers. Complementary California and Key West facilities could subject technologies to an array of environmental conditions that may be more reflective of the range of conditions vessels encounter during the course of international trade. The budget to establish such a facility, including capital start-up cost, personnel, operating expenses and equipment is estimated at approximately \$10 million over three years.

7C4. Identify and communicate opportunities for interagency funding of research necessary for improved management.

(AISWG) Year 3

Discussion: Consider developing a grant program administered by managers that pools money on an annual basis to do directed research studies.

OBJECTIVE 8: LAWS & REGULATIONS

Ensure state laws and regulations promote the prevention and management of AIS introductions.

Currently, California has numerous laws, regulations and policies that pertain to the introduction, distribution, importation, transportation, possession, propagation, planting, sale and release of non-native plants and animals. These authorities are spread over several agencies. This objective aims to review regulations for gaps and overlaps, and explore the need for new AIS laws and regulations. This section will likely be expanded in the next version of the plan to include specific legislative and regulatory actions, as well as new policy directions.

STRATEGY 8A: LAWS & REGULATIONS

Review the laws and regulations governing AIS in California for gaps and overlaps, compare them to other state and federal AIS laws, and recommend changes to improve our ability to protect California's waters from the introduction and spread of AIS.

ACTIONS

8A1. Establish a regulatory review committee.

(CAAIST, FA, RI, SH) Year 2

Discussion: This committee, to be comprised of representatives from agencies and non-governmental organizations, among others, will emphasize working in a coordinated fashion with existing state, federal and international programs. The committee will invite input from all groups affected by any proposed vector control measures and undertake step 8A2.

8A2. Identify the potential for improved regulatory coordination among state agencies.

(CAAIST) Ongoing

Discussion: The regulatory review committee will also coordinate this effort with tasks under Objective 1.

8A3. Pursue the authority to establish an interagency California AIS rapid response program, as detailed in Strategy 4A.

(AE, SH) Year 1

8A4. Explore the need for new legislation to address gaps in the state's authority to manage AIS and to strengthen California's AIS-related statutes.

(CAAIST, AISWG) Ongoing

Discussion: Legislation may be needed to address the results of the vector assessments and resulting management recommendations, developed under Objective 2.

8A5. Perform an interagency review to assess the current system for regulating plant and animal importations and the necessity of further restrictions.

(DFA, DFG, FA, AISWG) Year 1 and Ongoing

8A6. Explore the need for new or modified regulations to address gaps in the state's authority to manage AIS and to strengthen California's AIS-related statutes, taking into account any findings of Action 8A6.

(CAAIST, AISWG) Ongoing

8A7. Based on findings from Action 8A7, develop new regulations and pursue adoption.

(AE, DFA, DFG) Ongoing

7. PRIORITIES, IMPLEMENTATION & PLAN EVALUATION

Priorities

During the development of this plan, the state agencies with primary AIS responsibilities discussed their priorities for AIS management. They considered the more than 80 actions identified (out of 163 total) that were identified as high priorities by various attendees at the three 2006 public meetings (see Appendix E). The priorities of agencies and public meeting attendees overlapped.

In December 2006, representatives of these agencies met to determine which actions should be implemented during state fiscal years 2007-2008 and 2008-2009 (i.e. July 2007 through June 2009) and which entities should have primary responsibility for each of the actions. The results of that meeting are shown in the CAISMP Implementation Matrix (Table 5). At that meeting it was also decided to develop a separate table showing the amount of funds expended on actions during fiscal years 2005-2006 and 2006-2007. This information is shown in Table 6. Both tables are included at the end of this chapter. DFG's effort to collect expenditure information for ongoing projects met with limited success, and therefore, Table 6 is not complete. It is, however, a start at tracking this information in a comprehensive manner. A more thorough table will be developed in future years to assist with assessment and planning.

In more general terms, the highest priorities of this plan are as follows:

1. Formalize the creation of two major new coordinating entities, one entirely for state agencies and one for a broader range of AIS interests (Action 1A2 and 1A3).
2. Formalize a process for the team of state AIS managers to share information with, and get input from agency executives (Action 1A1).
3. Secure funding for state AIS staff (Action 1C3).
4. Conduct a statewide assessment of the risk from four specific AIS vectors: commercial fishing, recreational boating, live bait, and live imported seafood (Actions 2B7, 2C1, 2D1, and 2D4).
5. Fund and launch early detection and rapid response actions, including efforts to coordinate various AIS monitoring programs and expand monitoring of freshwater systems (Strategies 3A and 4A, and Appendix A).

If these core actions can be accomplished, it will provide a basis for pursuing the larger list of AIS management priorities in the future.

Plan Evaluation

To evaluate the effectiveness of the plan, formal evaluation will be conducted on a regular basis. Systematic monitoring and evaluation of the progress made toward implementation of actions and their effectiveness will be undertaken by the agencies designated as leads on the implementation table. Updates will be compiled by DFG on an annual basis.

In addition to an evaluation of efforts and implementation, the objectives, strategies and actions will also come under regular review, as this plan is intended to adapt to changing circumstances. It is envisioned that this evaluation will be conducted by a Plan Implementation Panel under the direction of the CAAIST. Evaluations will be conducted following years one, two and five; and on an “as needed” basis after that. Before updating the plan and Implementation Matrix, performance based criteria will be established to determine if the agencies and entities included are appropriate.

Table 5
California Aquatic Invasive Species Management Plan
IMPLEMENTATION TABLE
(see Chapter 6 for complete descriptions of actions)

Explanation of Terms

- 1) Implementing Entity: Since this is a state plan, these are state agencies, entities within state agencies, or groups that include state agencies that fund and have primary accountability and authority for an action being carried out.
- 2) Cooperating Organizations: Entities whose participation is needed or may be needed to conduct an action.
- 3) Non-governmental Organizations (NGOs): Non-profit organizations directly involved in AIS research or control activities.
- 4) Stakeholders: Relevant recreation, industry, local government, landowner representatives and special interest groups.
- 5) Plan Implementation and Science Advisory Panels: Panels created per Action 1A5 to help the work of the CAAIST and AISWG.

Acronyms

AISWG	Aquatic Invasive Species Working Group (see Action 1A2)
BOE	Board of Equalization
CAAIST	California Agencies Aquatic Invasive Species Team (see Action 1A3)
CACASA	California Agricultural Commissioners and Sealers Association
CAISMP	California Aquatic Invasive Species Management Plan
CALFED	CALFED Bay-Delta Program
CeNCOOS	Central and Northern California Ocean Observing System
DBW	California Department of Boating and Waterways
DFA	California Department of Food and Agriculture
DFG	California Department of Fish and Game
/OSPR	/Office of Spill Prevention and Response
DOE	California Department of Education
DPR	California Department of Parks and Recreation
DWR	California Department of Water Resources
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SCC	State Coastal Conservancy
SCCOOS	Southern California Coastal Ocean Observing System
Sea Grant	California Sea Grant College Program
SLC	California State Lands Commission
SWRCB	State Water Resources Control Board
UCCE	University of California Cooperative Extension
WCB	Wildlife Conservation Board

Other Abbreviations

AE	Agency Executives (Upper management of state agencies and departments)
SH	Stakeholders
FA	Federal Agencies
FY	State fiscal year (July 1 through June 30)
RI	Research Institutions (e.g. Public and private universities, government research organizations, etc)

Implementation Year



- | |
|---|
| Starts Year 1 (FY 2007/2008) |
| Ongoing (started during or before FY 2006/2007) |

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 1. COORDINATION AND COLLABORATION								
Improve coordination and collaboration among the people, agencies and activities involved with AIS.								
INTERNAL STATE COORDINATION								
1A1	Develop an executive level consultation process.		AE	CAAIST, RI, NGOs, SH				
1A2	Formalize the California Agencies AIS Team (CAAIST).		AE					
1A3	Establish, fund and staff an Aquatic Invasive Species Working Group (AISWG).		AE	CAAIST, RI, NGOs, SH				
1A4	Evaluate the need for an invasive species center.		AE	NGOs, RI, SH, CAAIST				
1A5	Form and fund technical advisory panels.		CAAIST, AISWG					
1A6	Draft and update a list of AIS at high risk for introduction.		CAAIST	FA, RI, Sea Grant, UCCE, NGOs, SH				
1A7	Identify lead state agency for particular AIS, water bodies and invasion vectors.		AE	CAAIST				
1A8	Identify agency personnel required for AIS management.		AE	CAAIST				
1A9	Improve state websites related to AIS.		CAAIST					
1A10	Assess effectiveness of and gaps in state AIS programs.		AISWG	Plan Imp. Panel				
1A11	Coordinate AIS management with SWRCB & RWQCBs.		CAAIST	SWRCB, RWQCBs				
1A12	Develop and update AIS expert list.		CAAIST	Science Advisory Panel				
1A13	Develop boilerplate AIS language for official agency review.		CAAIST					

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 1. COORDINATION AND COLLABORATION (continued)								
LOCAL, NATIONAL AND INTERNATIONAL COORDINATION								
1B1	Identify AIS reps in government agencies and NGOs.		CAAIST	RI, FA, NGOs, SH				
1B2	Identify conflicts and overlaps among government and NGO AIS programs.		CAAIST	RI, FA, NGOs, SH				
1B3	Invite community groups for AIS planning and education.		AISWG					
1B4	Expand participation in local AIS efforts and task forces.		AISWG	SH				
1B5	Expand participation in regional, national and international AIS task forces.		AE, CAAIST, RI					
1B6	Partner with Mexico, Canada, Pacific Coast and Colorado River states.		AE, RI	AISWG				
1B7	Participate in national and international conferences.		AE, CAAIST, RI					
FUNDING								
1C1	Identify and apply for state and national grant funding.		CAAIST, RI, NGOs					
1C2	Establish stable, long-term funding to help implement this plan.		AE	CAAIST				
1C3	Provide state funding for AIS positions.		AE	CAAIST				
1C4	Provide state funding for rapid response actions.		AE					
1C5	Hire a funding development specialist.		AE	CAAIST				
1C6	Provide new funding mechanisms.		AISWG					

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 2. PREVENTION								
Minimize the introduction and spread of AIS into and throughout California waters.								
REGIONAL VECTOR ASSESSMENT								
2A1	Rank AIS vector importance in different regions of California.		RI	DFG				
COMMERCIAL VESSELS & MARITIME ACTIVITIES								
2B1	Quantify ballast water and hull fouling vectors and assess invasion risk.		SLC	RI	2,013*	2,593*		
2B2	Continue and improve state ballast water inspection and enforcement program.		SLC					
2B3	Implement discharge standards for treated ballast water.		SLC					
2B4	Identify and address gaps in the Marine Invasive Species Act.		AISWG	SLC, DFG				
2B5	Develop a commercial vessel fouling outreach and management program.		SLC	Sea Grant				
2B6	Investigate how moving maritime structures can contribute to AIS dispersal.		DFG, SLC	RI, FA				
2B7	Quantify and assess the role of commercial fishing vessels as AIS vectors.		DFG	RI, NGOs, SH, FA		100		100
2B8	Develop a commercial fishing outreach and management program.		DFG	AISWG, FA				
*SLC contracts with BOE to collect the Fee from qualifying voyages. The numbers above do NOT include BOE's budget.								
RECREATION								
2C1	Quantify and assess recreational boating as an AIS vector.		DBW, DFG	RI, SH		150		150
2C2	Develop a recreational boating outreach and management program.		DBW	UCCE, Sea Grant				
2C3	Develop a watercraft inspection program for high priority boat launch sites.		DBW, DFG, DPR	SH				

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 2. PREVENTION (continued)								
2C4	Quantify and assess recreational fishing as an AIS vector.		DFG, DBW	RI, SH				
2C5	Develop a recreational fishing outreach and management program.		DFG	UCCE, Sea Grant				
2C6	Develop guidelines for: disposal of invasive species, cleaning of gear and equipment, disposal of bait.		DFG, DBW	Sea Grant				
BAIT, LIVE SEAFOOD, AQUACULTURE & AQUARIUM								
2D1	Quantify and assess bait as an AIS vector.		DFG	RI		125		125
2D2	Work with the bait industry to develop prevention strategies.		DFG	UCCE, SH				
2D3	Develop a bait outreach and management program.		DFG	UCCE, SH				
2D4	Quantify and assess imported live seafood as an AIS vector		DFG, DFA			125		125
2D5	Work with live seafood industry to develop preventative strategies.		DFG, DFA	UCCE, Sea Grant				
2D6	Develop an imported live seafood outreach and management program.		DFG, DFA	UCCE, Sea Grant				
2D7	Assess risks posed by water handling systems.		SWRCB, DFG	RI, SH				
2D8	Educate aquaculture industry on containment systems.		DFG	SH, UCCE				
2D9	Develop an aquaculture outreach and management program.		DFG	UCCE				
2D10	Quantify and assess how aquarium and aquascaping trades contribute to AIS introductions.		DFG, DFA	RI		125		125
2D11	Work with aquarium, water gardens and other industries on accessible disposal.		DFG, DFA	UCCE, FA		20		20

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 2. PREVENTION (continued)								
2D12	Implement an aquarium and aquascaping outreach and management program.		DFG, DFA	UCCE, FA				
FISHERIES ENHANCEMENT								
2E1	Quantify and assess fisheries enhancement as an AIS vector.		DFG	RI		50		50
2E2	Review DFG practice of intentional introduction of non-native species for recreational purposes.		DFG	RI				
2E3	Reduce unauthorized stocking of non-natives species.		DFG					
2E4	Weigh benefits of mosquitofish introduction.		DFG	RI				
RESEARCH, MANAGEMENT & EDUCATION								
2F1	Quantify and assess research, resource management and educational activities as AIS vectors.		AISWG			125		125
2F2	Establish protocols to minimize spread of AIS by these activities.		DFG, AISWG	RI				
2F3	Evaluate regulations and protocols for in-water research.		DFG	SWRCB, RI				
2F4	Quantify and assess live aquatic species shipments for research as an AIS vector.		DFG	RI				
CONSTRUCTION & RESTORATION								
2G1	Quantify and assess construction activities as an AIS vector.		DFG	RI				
2G2	Work with industry to develop equipment decontamination guidelines.		DFG, SLC, DPR, FA	RI				
2G3	Develop a construction outreach and management program.		DFG, SLC, DPR, FA	UCCE				
2G4	Quantify and assess restoration activities as an AIS vector.		AISWG	RI				

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 2. PREVENTION (continued)								
2G5	Encourage the use of native species.		DFG, SCC	AISWG				
2G6	Develop a restoration outreach program.		AISWG	UCCE				
WATER DELIVERY & DIVERSION SYSTEM								
2H1	Quantify and assess the water delivery and diversion system as an AIS vector.		DWR					
2H2	Develop an outreach and management program for the system.		DWR	UCCE, Sea Grant				
ENFORCEMENT & INSPECTION								
2I1	Increase staffing and hours at DFA Border Protection Stations.		DFA	SH				
2I2	Develop guidelines for border inspections.		DFA, DFG			1		
2I3	Increase DFG enforcement of current regulations on prohibited and restricted species.		DFG	SH				
2I4	Ensure adequate staffing and cargo inspection guidelines for port and airport enforcement.		FA	AISWG, SLC				
2I5	Continue disease sampling for shipments and stocks of live aquatic species.		DFG					
2I6	Identify mail order, online vendors selling CA prohibited and restricted species.		AISWG	RI				
OBJECTIVE 3. EARLY DETECTION & MONITORING								
Develop and maintain programs that ensure the early detection of new AIS and the monitoring of existing AIS.								
EARLY DETECTION								
3A1	Assess current monitoring of state waters for early detection opportunities.		CAAIST	RI, CeNCOOS, SCCOOS		100		100

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 3. EARLY DETECTION & MONITORING (continued)								
3A2	Assess how the state's Marine Invasive Species Program monitoring can aid early detection.		SLC	DFG, RI				
3A3	Develop a statewide approach to early detection.		CAAIST	AISWG		100		100
3A4	Outreach to those regularly sampling state waters.		CAAIST	UCCE, Sea Grant				
3A5	Create and train a statewide citizen monitoring network.		CAAIST	UCCE, SH				
3A6	Engage professional divers in the early detection network.		CAAIST	AISWG, NGOs		100		100
3A7	Review efficacy of the state's AIS early detection systems.		AISWG					
LONG-TERM MONITORING								
3B1	Assess long-term AIS monitoring of state waters.		AISWG	CeNCOOS, SCCOOS, DFG/OSPR				
3B2	Coordinate with ocean observing groups.		AISWG	CeNCOOS, SCCOOS				
3B3	Monitor locations with a high invasion rate.		AISWG	DFG/OSPR, RI				
3B4	Monitor the population growth and dispersal of established AIS.		AISWG	DFG/OSPR, RI				
3B5	Fund the incorporation of DFG's historical stream surveys and report findings into a central database.		DFG					
3B6	Include maps of existing AIS in California waters in DFG BIOS system.		DFG	DFA				
3B7	Review the efficacy of long-term monitoring systems.		AISWG					

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 4. RAPID RESPONSE & ERADICATION								
Establish systems for rapid response and eradication.								
RAPID RESPONSE								
4A1	Develop and implement a statewide rapid response plan.		DFG	AISWG				100
4A2	Evaluate and coordinate existing systems for reporting AIS sightings.		CAAIST	AISWG				10
4A3	Develop species- and/or location-specific rapid response plans.		AISWG					
4A4	Explore permanent funding to implement rapid response.		AE	NGOs, SH				
ERADICATION								
4B1	Review effectiveness of eradication programs.		AISWG					
4B2	Continue and complete current eradication efforts.		AISWG					
4B3	Standardize criteria for identifying priority species for eradication.		CAAIST	RI, Science Advisory Panel				
4B4	Develop a method to prioritize sites of AIS invasion concern.		AISWG	Science Advisory Panel				
4B5	Identify ecologically sensitive waters requiring additional precautions.		AISWG	Science Advisory Panel				
OBJECTIVE 5. LONG-TERM CONTROL & MANAGEMENT								
Control the spread of invasives and minimize their impacts on native habitats and listed species.								
CONTROL								
5A1	Develop a method or criteria to prioritize control actions.		CAAIST, FA	RI				
5A2	Prioritize control efforts for existing and new organisms of concern.		CAAIST, FA	RI				

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 5. LONG-TERM CONTROL & MANAGEMENT (continued)								
5A3	Continue ongoing control programs.		DFA, DFG, SCC, FA	RI				
5A4	Develop species- and site-specific control plans.		CAAIST, FA	RI				
5A5	Provide technical assistance to watershed councils, irrigation districts and other groups.		AISWG	UCCE, CACASA, RCD				
LIMIT DISPERSAL TO NEW AREAS								
5B1	Establish boat washing stations and disposal facilities at infested waters.		DFG, DBW, DFA	SH				
5B2	Install AIS warning and information signs in infested areas.		DBW, DFG, DPR	SH				
5B3	Use volunteer monitors to conduct AIS inspections.		DFG, DBW	NGOs, SH, FA				
5B4	Develop criteria for enforcing closure of infested areas.		DFA, DFG, DBW	SH				
PROTECT NATIVES								
5C1	Prioritize ecologically sensitive areas at risk of AIS impacts.		AISWG					
5C2	Coordinate entities to meet AIS protection and restoration objectives.		AISWG					
5C3	Develop GIS maps showing coincidence of AIS and critical ecosystems.		DFG, DFA	DFG/OSPR, RI				
5C4	Establish guidelines for when AIS eradication or control will occur in sensitive areas.		AISWG					
5C5	Adopt guidelines on best practices for timber and agricultural activities.		AISWG					
5C6	Assess guidelines for preventing AIS spread in habitat restoration and shoreline landscaping projects.		CAAIST				10	10

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 6. EDUCATION & OUTREACH								
Increase education and outreach efforts to ensure awareness of AIS threats and management priorities throughout California.								
OUTREACH								
6A1	Inventory education and outreach efforts and develop a state AIS communication strategy.		CAAIST	UCCE, Sea Grant				
6A2	Partner with ongoing outreach campaigns.		CAAIST	UCCE, Sea Grant				
6A3	Develop a DFG Communications Plan.		DFG					
6A4	Develop posters, brochures and articles for industry sectors and user groups.		AISWG	UCCE, Sea Grant				
6A5	Develop permanent interpretive displays at marinas, boat ramps and fishing sites.		AISWG	SH				
6A6	Work directly with industry trade shows to deliver the AIS message.		DFG, DFA, DBW, SLC	Sea Grant, RI, SH				
6A7	Present AIS information at public gatherings.		AISWG	Sea Grant, SH				
6A8	Include AIS information in state hunting, fishing and boating regulations and licenses.		DFG, DBW					
6A9	Include AIS information in local fishing and recreational publications.		DFG, DBW, UCCE, Sea Grant, NGOs					
6A10	Develop and distribute AIS identification cards.		AISWG	SH, Sea Grant				
6A11	Encourage industries to offer noninvasive alternatives to AIS.		AISWG	SH				
6A12	Partner with stakeholders and interest groups to broaden education efforts.		AISWG	SH				
6A13	Educate waterfront and shoreline property owners about AIS.		DBW, SCC	NGOs, SH				

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 6. EDUCATION & OUTREACH (continued)								
6A14	Develop and offer AIS management classes for professional organizations.		AISWG	UCCE, SH				
6A15	Continue state education measures concerning ballast water.		SLC	Sea Grant				
POLICYMAKERS								
6B1	Brief decision makers and legislators on AIS management progress.		CAAIST, FA	RI, NGOs, SH				
6B2	Brief the Fish and Game Commission, SLC, OPC, SCC and CCC.		DFG	CAAIST				
RESOURCE MANAGERS & RESEARCHERS								
6C1	Increase AIS awareness among scientific and natural resource managers.		RI	CAAIST, FA, NGOs, SH				
6C2	Educate researchers on AIS containment, disposal methods and legal restrictions.		DFA, DFG	RI				
6C3	Develop an AIS regulatory handbook.		CAAIST, FA					
6C4	Share information on current mechanical, chemical, biological and physical control methods.		AISWG	SH				
6C5	Disseminate guidelines to promote use of native plants.		CAAIST	UCCE, Sea Grant				
6C6	Encourage the training of more taxonomists.		AISWG	NGOs, SH, RI				
SCHOOLS								
6D1	Train speakers to give guest presentations at schools.		AISWG	NGOs, SH				
6D2	Assess existing K-12 environmental education curricula.		UCCE, Sea Grant	DOE				

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 6. EDUCATION & OUTREACH (continued)								
6D3	Integrate AIS issues into service and education projects.		UCCE, Sea Grant	DOE				
6D4	Inform teachers about proper disposal methods for organisms.		UCCE, Sea Grant	DOE				
GENERAL PUBLIC								
6E1	Develop press kits.		DFA, DFG			100		100
6E2	Increase local TV, radio and newspaper media coverage.		CAAIST	UCCE, Sea Grant, NGOs, RI				
6E3	Identify state publications and websites to add AIS information.		CAAIST	UCCE, Sea Grant, NGOs, RI				
6E4	Develop multicultural educational materials.		UCCE, Sea Grant	AISWG				
6E5	Develop AIS traveling trunks and portable presentation boards.		UCCE, Sea Grant	AISWG				
OBJECTIVE 7. RESEARCH								
Increase research on the baseline biology of AIS, the ecological and economic impacts of invasions, and control options to improve management.								
BASELINE BIOLOGY								
7A1	Host workshops to develop AIS research priorities and identify gaps.		RI	AISWG				
7A2	Assess, continue and complete current studies.		RI	AISWG				
7A3	Develop a strategy to communicate and support research needs.		AISWG	RI				
ECONOMICS								
7B1	Perform economic impact studies on AIS effects.		CAAIST	RI		200		200

Table 5. CAISMP Implementation Table

Tasks		Priority *	Implementing Entity	Cooperating Organizations	Year 1 Planned Efforts (FY07-08)		Year 2 Planned Efforts (FY08-09)	
Number	Title/Summary				Dedicated	Requested	Dedicated	Requested
					\$1,000	\$1,000	\$1,000	\$1,000
OBJECTIVE 7. RESEARCH (continued)								
7B2	Assess and compare costs of different management techniques.		RI	AISWG				
MANAGEMENT OPTIONS								
7C1	Evaluate efficacy of AIS management methods.		AISWG	RI				
7C2	Investigate the efficacy of invasion prevention techniques.		AISWG	RI				
7C3	Consider test center to evaluate ballast water treatment technologies.		SLC					
7C4	Identify opportunities for interagency funding of AIS management research.		AISWG					
OBJECTIVE 8. LAWS & REGULATIONS								
Ensure State laws and regulations promote the prevention and control of AIS.								
LAWS & REGULATIONS								
8A1	Establish a regulatory review committee.		CAAIST, FA	RI, SH				
8A2	Identify the potential for improved regulatory coordination.		CAAIST					
8A3	Pursue the authority to establish an interagency rapid response program.		AE	SH				
8A4	Explore the need for additional state authority for AIS management.		CAAIST	AISWG				
8A5	Review current system for regulating plant and animal importations.		DFA, DFG, FA	AISWG				
8A6	Explore how new or modified regulations can bridge authority gaps.		CAAIST	AISWG				
8A7	Develop and pursue the adoption of new regulations.		AE	DFA, DFG				

Table 6 – Funds Spent on Ongoing AIS Programs and Activities

Name of Program or Activity	Implementing Entity ¹	CAISMP Action Number(s)	FY 05/06 ²	FY 06/07
Aquatic and Riparian Invasive Species Control on DFG Lands (One Time Funding)	DFG	5A2		\$720,000
Aquatic and Riparian Invasive Species Control on DFG Lands (Regular Funding)	DFG	5A2	\$160,000	\$160,000
Wetlands Invasive Plant Control	WCB	5A2		\$3,610,000
Riparian Invasive Plant Control	WCB	5A2		\$1,000,000
Santa Clara River Invasive Species Control (Santa Clara River Trustee Council Grants)	DFG	5A2		\$507,700
Santa Clara River Invasive Species Research (Santa Clara River Trustee Council Grants)	DFG	7C1		\$100,000
Santa Clara River - Education for Restoration Workers	DFG	2G2, 2G3		\$24,734
Santa Clara River Invasive Species Monitoring	DFG	3B4		\$200,285
Santa Clara River - Public Outreach and Education (est. portion for Invasive Species)	DFG	6E5,6A4, 6A7		\$25,000
Shellfish Health Laboratory	DFG	2D1	\$10,000	\$10,000
Shellfish Health Laboratory	DFG	2D4	\$10,000	\$10,000
Shellfish Health Laboratory	DFG	2D7	\$70,000	\$70,000
Shellfish Health Laboratory	DFG	2D8	\$10,000	\$10,000
Shellfish Health Laboratory	DFG	2D10	\$20,000	\$20,000
Shellfish Health Laboratory	DFG	2F2	\$10,000	\$10,000
Marine Invasive Species Program – Invasive Species Monitoring	DFG/OSPR	3B3, 7C2	\$1,080,000	\$1,080,000
Marine Invasive Species Program – Commercial Vessel Vectors	SLC	2B1	\$1,531,000	\$2,013,000
Quagga Mussel Response – Unified Command participation, planning and logistics, dive and surface surveys, border inspection stations, public outreach	DFG, DFA	4A3, 2I1 & many others		\$1,048,119
Quagga Mussel Response – Unified Command participation, eradication planning, dive inspections	DWR	4A3, 5A4,2H1		\$36,320

¹ See “Explanation of Terms” and “Acronyms” above Table 5.

² This table shows funds that were allocated in the 05/06 and 06/07 fiscal years. There were additional AIS projects being worked on in 05/06 and 06/07 that were not included in the table because they were funded in previous years.

Table 6 – Funds Spent on Ongoing AIS Programs and Activities

Name of Program or Activity	Implementing Entity ¹	CAISMP Action Number(s)	FY 05/06 ²	FY 06/07
Quagga Mussel Response – Training surface survey units	DWR	4A3		\$3,624
Quagga Mussel Response – Outreach to boaters	DBW	4A3		\$400,000
Aquatic Weed Control (water hyacinth and <i>Egeria densa</i>)	DBW	5A3	\$7,000,000	\$7,000,000
Hydrilla Eradication Program	DFA	3B4, 4B2,5A3	\$2,100,000	\$2,100,000
Coordination and Collaboration Activities	Sea Grant	1A4, 1C1, 1C2, 1C3	\$9,000	\$9,000
Commercial Vessels and Maritime Activities	Sea Grant	2B1, 2B2, 2B3, 2B6	\$137,250	\$137,250
Reduce AIS introductions related to recreational activities	Sea Grant	2C1, 2C4, 2C6	\$9,000	\$9,000
Reduce AIS introductions related to the live seafood industry	Sea Grant	2D5, 2D6	\$4,500	\$4,500
Early detection program development	Sea Grant	3A4, 3A6	\$11,250	\$11,250
Identify and monitor locations with high AIS invasion rates	Sea Grant	3B3	\$50,000	\$50,000
Work with volunteers to conduct AIS inspections at heavily used boat access areas	Sea Grant	5B3	\$4,500	\$4,500
Education and outreach to groups that may be a source of AIS introductions	Sea Grant	6A1, 6A2, 6A4, 6A5, 6A6, 6A7, 6A10, A12, 6A13	\$29,250	\$29,250
Increase awareness of AIS among, and share information on control methods with, scientific and natural resource management interests	Sea Grant	6C1, 6C4	\$4,500	\$4,500
Increase awareness of AIS in the educational system	Sea Grant	6D2, 6D4	\$4,500	\$4,500
Increase awareness and knowledge of AIS by the general public	Sea Grant	6E2, 6E3, 6E4, 6E5	\$9,000	\$9,000
Baseline biological studies on AIS	Sea Grant	7A2	\$60,000	\$60,000
Economic assessment of different AIS management techniques	Sea Grant	7B2	\$9,000	\$9,000

¹ See “Explanation of Terms” and “Acronyms” above Table 5.

² This table shows funds that were allocated in the 05/06 and 06/07 fiscal years. There were additional AIS projects being worked on in 05/06 and 06/07 that were not included in the table because they were funded in previous years.

Table 6 – Funds Spent on Ongoing AIS Programs and Activities

Name of Program or Activity	Implementing Entity ¹	CAISMP Action Number(s)	FY 05/06 ²	FY 06/07
Northern Pike Containment System at Lake Davis	CALFED	5A3	\$2,000,000	
Lake Davis Pike Eradication Project: Planning Feasibility Phase	CALFED	4B2		\$5,800,000
Lake Davis Pike Eradication Project: Implementation Phase	CALFED	4B2		\$11,700,000
Invasive Spartina Monitoring	CALFED	3B4,5A3		\$1,234,396
Total of Reported Activities			\$14,342,750	\$39,234,928

¹ See “Explanation of Terms” and “Acronyms” above Table 5.

² This table shows funds that were allocated in the 05/06 and 06/07 fiscal years. There were additional AIS projects being worked on in 05/06 and 06/07 that were not included in the table because they were funded in previous years.

8. CASE STUDIES IN ERADICATION & CONTROL

See also the explanation of species names in the introductory matter.

1. RAPID RESPONSE IN SAN DIEGO: CAULERPA

Invasion: *Caulerpa taxifolia* is a marine alga native to the warm waters of the Red, Indo-Pacific and Caribbean seas. The bright-green plant, which has feathery, fern-like fronds extending upward from a main stem, is fast-growing and easy to cultivate. *C. taxifolia* gained popularity as an aquarium plant in the 1970s. In the early 1980s, a strain of *C. taxifolia* that had adapted to temperate waters escaped from Germany's Stuttgart Aquarium into the northern Mediterranean. By 2001, the temperate strain of *C. taxifolia* carpeted more than 30,000 acres of coastal waters from Spain to Italy, moved into the Croatian Adriatic, and from there, spread to Northern Africa. As the plant spread, it excluded native plants and animals.

Nearly twenty years after its introduction into the Mediterranean Ocean, *C. taxifolia* was observed in the Americas. In July 2000, biologists conducting an eelgrass restoration project in Carlsbad, California, near San Diego, found monoculture patches of *C. taxifolia* covering approximately 1,100 square meters of a coastal estuary known as Agua Hedionda Lagoon. The resulting press coverage brought attention to a previously known second infestation of scattered individual plants over seven acres of Huntington Harbour near Los Angeles. Genetic tests confirmed that both areas had been invaded by clones of the aquarium strain, suggesting aquarists had dumped the contents of their saltwater tanks into California waters.

Concern: *C. taxifolia* is one of the world's most notorious marine invasives. Though tropical in origin, the clone cultivated in home aquaria has adapted to waters as cool as 50 degrees F. The aquarium strain can grow on rock, sand and mud, and increase in size by an inch per day, developing in monoculture patches that are both taller and more vigorous than its wild ancestor, which is genetically distinct from the aquarium strain and is not known to be invasive. Sexual reproduction has not been documented, but *C. taxifolia* reproduces easily, regenerating from small fragments broken off from the main plant. *C. taxifolia* is not particularly vulnerable to predation. Chemicals in its tissues make it unpalatable to most animals. In the laboratory, *C. taxifolia* has survived a wide array of kill techniques, including high doses of herbicides and algicides as well as light exclusion for more than one month.

Response: The plant's notoriety helped galvanize an immediate response to the California infestations. Plant samples taken from Agua Hedionda Lagoon were identified literally overnight as *C. taxifolia*. A task force consisting of representatives from more than ten state, federal and local agencies plus local stakeholders and experts met within days to determine how to manage the outbreaks. Given the speed with which *C. taxifolia* had invaded the

Mediterranean and the ecological havoc that ensued, the task force approved a plan calling for an immediate eradication response. Regulatory agencies agreed in advance to green-light permits for eradication work to begin within two weeks.

Both infestations occurred in bodies of water with restricted ocean access. This enabled kill procedures to take place in areas sheltered from ocean waves, and made surveys for regrowth safer and easier to conduct. In Agua Hedionda, divers surveyed the lagoon and mapped patches of the alga. The patches were covered by tarpaulins and the edges secured by sandbags and rebar. Solid chlorine pucks were placed beneath the tarps to make up a five percent bleach solution. Before the tarpaulins were lifted, sediment cores were grown out in the laboratory to determine whether any viable *C. taxifolia* remnants remained. Meanwhile, teams of divers continuously resurveyed the 200-acre lagoon to ensure no other plants had been missed. A similar tarp, bleach, and survey protocol was followed at Huntington Harbour. The last specimens of *C. taxifolia* were found outside the tarpaulins at both sites in fall of 2002. The alga was officially declared eradicated in July 2006. All told, the eradication effort cost \$7.7 million, including planning, field work, monitoring and reports.

Lessons: Several factors contributed to the success of *C. taxifolia* eradication in southern California. Rapid identification, an expedited process and cooperation among stakeholders, plus adequate funding and follow-up, all contributed to eradication. Biologists were aware of *C. taxifolia*'s invasion of the Mediterranean and rapidly identified the problem. Concern over a similar outbreak in California spurred the prompt formation of an invasion task force. Stakeholders were identified within days and agreed to participate in response plan discussions. The specter of the alga's escape prompted task force members to aim for eradication despite the fact that some native species, such as eelgrass and estuary invertebrates, would be harmed. Team members divided tasks, some turning their full attention to eradication while others concentrated on permitting applications and approval. Regulatory agencies agreed to cooperate with the eradication plans and expedite permitting. Financing was adequate to maintain a sustained response. Intensive monitoring surveys were conducted for least three years to guard against any regrowth.

Background Studies:

Merkel & Associates, Inc. 2006. *Final report on eradication of the invasive seaweed *Caulerpa taxifolia* from Agua Hedionda Lagoon and Huntington Harbour, California*. Prepared for the Steering Committee of the Southern California Caulerpa Action Team.

2. ERADICATION EFFORT IN THE SAN FRANCISCO BAY ESTUARY: SMOOTH CORDGRASS

Invasion: Intentionally introduced to the San Francisco Bay Estuary in the 1970s to stabilize shorelines, smooth cordgrass spread rapidly, hybridized with Pacific cordgrass and today threatens thousands of acres of tidal marshes and restoration projects around the Bay. In 2000, surveyors tallied 470 acres of hybrid smooth cordgrass, while the original introduced parent had become quite rare. By 2003, the hybrids covered 2000 acres. The smooth cordgrass was not confined to certain areas; the invader was widely dispersed through 69,000 acres of tidal marsh and mudflats and had invaded every marsh restoration project in the Bay.

Concern: The hybridization between smooth and Pacific cordgrass resulted in a high degree of genetic variation, which allowed individual plants to survive in different parts of the marsh and to exploit open niches. Some hybrids grow well in higher marsh elevations while others flourish on open mudflats. Other adaptive qualities of the smooth cordgrass hybrids include the ability to produce up to 23 times more seed than the native, to grow taller and/or faster, and to tolerate higher or lower salinity. The hybrid cordgrass tends to grow in dense stands, turning diverse marshes into monocultural meadows, crowding out the meandering tidal channels used by native salt marsh species, and reducing fish habitat. This invasion sequence can also transform open mudflats into uniform expanses of cordgrass, destroying foraging habitat for shorebirds. Flood control channels are also threatened, as the cordgrass can significantly impede flow with increased siltation rates and biomass accumulation, threatening adjacent residential and commercial areas with flooding.

Response: In 2000, SCC began to organize a multi-agency, region-wide control effort in the San Francisco Estuary called the Invasive Spartina Project (ISP). With substantial funding from CALFED Bay Delta Program (CALFED), ISP surveyed and mapped the invasive cordgrass, evaluated a wide range of potential treatment strategies and methods, prepared environmental review documents under CEQA and NEPA, developed extensive partnerships with regional marsh owners and managers, obtained necessary permits (e.g., ESA Section 7 and CWA Section 402/NPDES), and prepared site-specific treatment plans for over 130 known infested marshes. ISP also coordinated funding from CALFED through SCC to the land owner/manager partners. In 2004, ISP partners initiated treatment efforts, which consisted of spraying selected infested marshes with glyphosate (Aquamaster(r), the aquatic version of Roundup(r)), and using light mechanical removal methods.

ISP faced a number of constraints as it attempted to respond to the fast-moving invasion of hybridized smooth cordgrass. Mechanical removal methods, such as mowing, sometimes aggravated the problem. Spraying was slow, difficult work. It had to be limited to days with no rain, low wind and periods of low tides, so as to minimize drift issues and keep the herbicide from washing off

of the surface of the plants. Targeted plants had to be entirely coated with the glyphosate herbicide to achieve maximum efficacy, which in most cases proved to be around 50% at best. Another problem was that glyphosate tends to become deactivated when it binds with sediment; since these bay waters contain a great deal of suspended sediment which is deposited on the cordgrass twice daily, much of the applied herbicide was rendered inactive before it even entered plant tissue.

To add to the difficulty, herbicide application had to take place in the late summer before the plants set seed and go dormant, but also had to be scheduled so as not to interfere with the breeding season of a federally endangered species, California clapper rail (February through August). Mowing and other mechanical removal methods could not be used in marshes frequented by the clapper rail.

In November 2004, ISP and USEPA hosted the Third International Conference on Invasive *Spartina*, where ISP shared its experiences with *Spartina* experts from around the world. At this meeting, ISP requested guidance regarding the feasibility and approach to controlling the hybrid cordgrass invasion. Conference participants were impressed by the level and complexity of the invasion problem and advised that control could potentially be achieved if the ISP proceeded immediately with an aggressive regional control program.

Before such a program could get underway, surveys for California clapper rails in the infested marshes had to be performed, as well as an analysis of the potential impacts of treating each site where the rail was present. ISP partnered with local bird, park and fish and wildlife groups to conduct coordinated annual Bay-wide clapper rail surveys. Their results directly informed treatment approaches.

In 2005, ISP targeted 132 infested areas, with a goal of treating 70-80 percent of the infestation in that year. ISP began using a new herbicide, imazapyr (Habitat(r)), which had been registered for use on August 30, 2005 in California and was known to be highly effective in eradicating invasive cordgrass in Willapa Bay, Washington. Imazapyr has several advantages over glyphosate. It does not require a 6-12 hour post-application period without tidal inundation, it is less toxic to aquatic organisms than glyphosate, and it can be used more sparingly and with greater success. One drawback is that it can damage non-target plants if it is over-sprayed, though preliminary observations of treated sites show normal seasonal regrowth of native marsh plants such as pickleweed.

In 2005, imazapyr was applied to 1,010 acres of invasive cordgrass, sprayed from amphibious tracked vehicles, helicopters, airboats, backpacks and trucks. Because the new herbicide requires less spray volume than glyphosate, application time was reduced by as much as one-third, and 2006 monitoring showed that it killed from 40-90% of the treated plants. Also, the 2005 results showed that helicopter application provided the best efficacy (up to 90% kill) and

lowest cost (\$250-\$350 per acre). In 2006, ISP partners treated more than 1,700 acres (including retreatment of the previous years sites), with 60% of that by helicopter. Based on the 2005 results and the demonstrated coordination and aggressive action of ISP partners in 2006, ISP envisions that, given continued adequate funding, non-native cordgrass could be effectively eradicated from the San Francisco Estuary within the next several years.

ISP and affected resource agencies are also starting to develop an "exit strategy" for ISP, whereby long-term monitoring and treatment responsibilities will be turned over to a network of informed land managers around the S.F. Bay Estuary.

Lessons: Years of frustrated attempts by individual landowners to manage invasive cordgrass on their properties demonstrated the need for a coordinated regional approach. Landowners could not control reinfestation from adjacent properties and had nearly given up by the time SCC initiated efforts through ISP. At the outset of ISP in 2000, non-native cordgrass infestation in the Bay was roughly one-third the area mapped in 2005. In the five years it took to develop the necessary budgeting, permitting and scientific framework to comprehensively tackle the problem, the infestation grew significantly. Because of substantial and reliable support from SCC, CALFED, the Bay Area environmental community and regional land managers, the ISP was able to adapt to the expanding scope of the problem, despite setbacks along the way.

One of the most difficult aspects of controlling an invasive species in a region that is highly urbanized and carefully monitored for its unique environmental values is coming up with a sufficiently rapid response. Environmental regulation around sensitive tidal marshlands had been instituted in response to urban growth, or in some cases, was designed to reflect specific issues: endangered species protection, or water use. By contrast, the cordgrass invasion in the Bay encompassed multiple jurisdictions, habitat types, developmental zones, political mindsets, animal and plant species and levels of enthusiasm. Currently there is no overarching mechanism to cut through the permitting process for an effort that is, in essence, aimed at controlling the rapid spread of a biological pollutant, and enhancing and maintaining the health of the environment. The experience of ISP shows that having a coordinated regional effort is critical for overcoming budgetary and regulatory obstacles. When that kind of alignment is absent, worthy projects of lesser scale would likely be unsuccessful.

Background Studies:

Daehler, CC and DR Strong. 1997. "Hybridization between introduced smooth cordgrass (*Spartina alterniflora*; *Poaceae*) and native California cordgrass (*S. foliosa*) in San Francisco Bay". *American Journal of Botany* 84(5): 607-611.

Daehler, CC, CK Antilla, DR Ayres, DR Strong and JP Baily. 1999. "Evolution of a new ecotype of *Spartina alterniflora* in San Francisco Bay." *American Journal of Botany* 86, 543-544.

Leson & Associates. 2005. "Use of imazapyr herbicide to control invasive cordgrass (*Spartina* spp.) in the San Francisco Estuary: Water quality, biological resources, and human health and safety." Prepared for the San Francisco Estuary Invasive *Spartina* Project/State Coastal Conservancy, Oakland, California. May 4, 2005.

Patten, K. 2002. "Smooth cordgrass (*Spartina alterniflora*) control with imazapyr". *Weed Technology* 16, pp. 826-832, 2002.

Patten, K. 2003. "Persistence and non-target impact of imazapyr associated with smooth cordgrass control in an estuary". *Journal of Aquatic Plant Management* 41, pp. 1-6.

San Francisco Estuary Invasive *Spartina* Project. 2004-2006 Studies covering site specifics, tidal marsh carrying capacity for clapper rails, rail distribution, field operations and an aquatic pesticide application plan, as well as EIRs and endangered species consultations, among other topics. Go to www.spartina.org/project_documents/.

3. CONFOUNDING COMPLICATIONS IN THE DELTA: BRAZILIAN ELODEA

Invasion: Brazilian elodea, commonly referred to as *Egeria*, is a fast-growing shallow-water submerged aquatic plant that now infests approximately 12,000 acres of the 50,000 surface acres of the San Joaquin/Sacramento River Delta (Delta). This species is a native of Brazil and Argentina, has also become widespread in New Zealand, Australia, Japan and Chile. In the U.S., it has invaded lakes and ponds along the western coast from Washington to California, through the South, and as far north as New Hampshire and Vermont in the Northeast. The plant, which has individual strands that resemble a long, furry brush, was identified in the Delta approximately 40 years ago. *Egeria*'s introduction is believed to have resulted from someone cleaning an aquarium and discarding the plant into the Delta.

The first recorded complaints by boaters in the Delta about *Egeria* mats impeding navigation are from 1988. The initial infestation appeared limited to a relatively small area. In 1999 aerial surveys indicated *Egeria* covered approximately 4,000 surface acres, or about 8% of the Delta. Six years later, in 2005, *Egeria* coverage had tripled to 12,000 acres, or about 24 percent of the Delta. *Egeria* is currently estimated to be spreading at a rate of about 1,000 acres per year. Some of the most heavily infested areas of the Delta are Rhode Island, where almost the entire 66 acres of the island are covered, and Franks Tract State Recreation Area, where the invader covers approximately 700 of the 900 acres. Thousands of acres of the Delta remain at risk; much of the ecosystem consists of freshwater areas less than 10 feet deep, the habitat in which *Egeria* thrives.

Concern: *Egeria* grows in subsurface mats that can be several feet thick. *Egeria* is a visible and immediate problem for boaters but an *Egeria* infestation also has a host of broader impacts. *Egeria* can obstruct waterways -- forcing boaters to stop frequently to clear propellers -- or in more extreme cases, prevent passage of large and small vessels. The San Joaquin County Sheriff's Office has reported that underwater vegetation may have contributed to a fatal boating accident. The plant can also impede migration of anadromous and pelagic fish. *Egeria* changes the architecture of shallow water ecosystems, forming walls between deepwater and inter-tidal habitat. Impenetrable mats of *Egeria* can force fish such as salmon and Delta smelt into more open waterways, where food resources may be scarce and where fish are more vulnerable to predators. The mats of *Egeria* can also impede water flows, crowd out native plants, entrap sediments, alter the food web by impeding light access, and clog agricultural and municipal water intakes.

Response: Legislative delays, treatment complexity and conflicts between herbicide application and native species protection have all been ongoing problems in the effort to eradicate *Egeria*. The initial response to the *Egeria* invasion was not rapid. Complaints of waterway obstruction by *Egeria* went on for nine years before state legislation authorizing DBW to address the invasion

passed in 1997. Two additional years passed before the legislature authorized funding to study *Egeria*. During this period, *Egeria* continued to expand in the Delta. A plant that had once been a localized nuisance soon became the most widespread aquatic weed in the Delta.

Once it was authorized to deal with the problem, DBW explored many different treatment and control options. These included a variety of herbicide types as well as mechanical harvesting. Department officials discovered that the harvesting of *Egeria* causes fragments to escape and freely float to new areas where they can take hold and sprout new growth elsewhere. Mechanical harvesting's unintended consequences made it a tool only to be used in an emergency.

Herbicides based on chelated copper have proven the most effective at destroying *Egeria*. Chelation helps prevent copper from entering the food web, and causing preferential binding to sediments; however, concerns over adding more heavy metals to the Delta forced DBW to turn to another herbicide, fluridone.

Fluridone treatment had its share of problems too. The herbicide is most effective against *Egeria* during the growth cycle of the plant. The peak growth period for *Egeria* is in early spring; however, spring in the Delta coincides with the spawning and migration of several protected species, including chinook salmon (out migration), steelhead trout (in-migration, spawning and out-migration), delta smelt (spawning) and candidate species green sturgeon (spawning).

Federal agencies, including NOAA's National Marine Fisheries Service (NOAA Fisheries Service) and USFWS have requested numerous toxicity tests to ascertain whether fluridone is harmful to these species. Research thus far has confirmed that the concentration of fluridone used to treat *Egeria* does not harm these species. For example, Chinook salmon fingerlings showed no toxic effects at or below concentration levels used by DBW. However, continued concern over the health of migrating and spawning species has led to limitations in fluridone treatment timing.

During the 2001 treatment season, DBW applied the herbicide during the summer months of July through September instead of during the optimum time frame of April through June as recommended by the manufacturer and other scientific studies. While the herbicide did prevent proliferation of some of the *Egeria*, it failed to substantially reduce the total acreage covered.

Monitoring during applications has been extensive. The fluridone treatments at each site are monitored using immunoassays analyzed to ensure applications are occurring at an efficacious rate and are within all published (agricultural and municipal) limits. The immunoassays are collected within the

treatment area, receiving waters and at all agricultural and municipal water intakes on a bi-weekly basis. DBW also takes water samples and monitors water quality of the treatment area to comply with its NPDES General Permit.

In 2005, NOAA Fisheries agreed for the first time to permit *Egeria* treatment to begin in spring in a few select sites. The new treatment schedule proved extremely effective. At one site, the treatment appears to have eliminated populations of *Egeria*, suggesting fluridone may only need to be applied in the future every second or third year to maintain control of the plant.

Treatment success has been measured using two relatively new methods. The plant grows in dense mats just below the surface of the water, where it is difficult to determine whether treatments have had an effect. DBW uses hydroacoustic measurements to determine biomass/volume of the plants prior to and after treatments have occurred. In addition, a new technique known as hyperspectral analysis now permits more refined estimates of *Egeria* coverage in the Delta. Each type of plant species, including *Egeria*, produces a unique spectrum of infrared reflectance. Aerial images of the Delta are taken before and after treatment using digital broad spectrum photographs. The light wavelengths captured in these images are then analyzed to determine a percentage of *Egeria* in a given waterway. Some analysis has been completed on watermilfoil, pepperweed, and purple loosestrife, as well. DFA, DFG, and DBW have all used hyperspectral analysis to measure the extent of coverage for these plants and other species since 2002.

In 2005, DBW treated 14 sites comprising 648 acres. The relatively small area reflects treatment crew limitations and other restrictions placed on the program. Additional funding for application crews and continued easing of restrictions on start dates could enhance DBW *Egeria* Control Program.

Lessons: First, delays in early identification, authorization and funding permitted *Egeria* to expand from a local waterway nuisance to an invasion widespread throughout the Delta. Second, new analytical tools have allowed scientists to gather basic data about the plant's growth characteristics and response to herbicide application. The information should help managers fine-tune future treatment methods. Third, toxicity testing is critical to prevent damaging resident wildlife populations and municipal water supplies and should be balanced against the need to control an invader known to be detrimental.

Background Studies:

Residues of Fluridone in Chinook Salmon Smolts from the Sacramento-San Joaquin Delta, California, 2005 conducted for DBW by the California Department of Fish and Game.

Fluridone (4AS) Dissipation During Typical Applications of Sonar (4AS), December 2004, Lars W.J. Anderson, Ph.D, conducted for DBW by the USDA-ARS Exotic and Invasive Weed Research, Davis, CA.

Residues of Fluridone and Diquat Dibromide in Sediment from the Sacramento-San Joaquin Delta, California, 2002-2005 - conducted for DBW by the California Department of Fish and Game.

Monitoring Aquatic Herbicide Treatment Efficacy on Egeria densa, Sacramento-San Joaquin Delta, California 2004-2006, conducted for DBW by ReMetix LLC.

4. STRATEGY FOR TAHOE BASIN: EURASIAN WATERMILFOIL

Invasion: Eurasian watermilfoil was first found to occur on the south shore of Lake Tahoe in 1975. By 1980, it became well established in the Tahoe Keys, a large marina complex on the south shore built out of a marshland. From 1994 to 1997 USDA/ARS confirmed the presence of Eurasian watermilfoil outside the Keys and found it to be spreading rapidly elsewhere in the lake. In 1997, it was reported that out of 200 acres of Eurasian watermilfoil in Lake Tahoe, 170 acres were in the Tahoe Keys. Aerial and boat surveys since 1995 indicate the plant continues to spread to new locations in the near shore zone and has established in several marinas and natural areas including Emerald Bay, which is leased to the California Department of Parks and Recreation (PARKS) as an underwater park. In addition to Eurasian watermilfoil, an equally aggressive aquatic weed, curly pondweed has recently been detected in Lake Tahoe.

Concern: Eurasian watermilfoil and other invasive aquatic weeds grow prolifically and aggressively invade native aquatic plant communities. Native aquatic plant communities provide many ecological benefits such as food and habitat for waterfowl, fish and other aquatic organisms. They also help maintain water quality by absorbing nutrients, providing oxygen and reducing shoreline erosion; however, when Eurasian watermilfoil is introduced, it dominates fresh water ecosystems quickly by way of buds and surface runners when fragmented by boat propellers. It also tolerates a wide range of environmental conditions, including low light levels, high or low nutrient waters, and freezing water temperatures. Eurasian watermilfoil also creates its own habitat by trapping sediment and initiating a favorable environment for further establishment. For these reasons, Eurasian watermilfoil can out-compete and eliminate native aquatic plants.

Aquatic weeds in Lake Tahoe impact several of Tahoe Regional Planning Agency (TRPA) thresholds including water quality, fish habitat, vegetation and recreation. Impacts pushing the limits of these thresholds include accelerated nutrient cycling, contributing to algae growth and decreased water clarity; lost or impaired fisheries habitat, including feed and cover; threats to native aquatic vegetation; and restrictions to boating, water skiing, fishing, and swimming due to dense matting (Eurasian watermilfoil has been linked to drowning deaths in other areas of the U.S.).

Response: In 2002, the Lahontan RWQCB began providing fact sheets to interested parties and agencies to promote awareness of Eurasian watermilfoil in Lake Tahoe, share information about options for controlling the growth and proliferation of this weed, and present the regulatory requirements applicable to weed management activities. Because Lake Tahoe is a bi-state water of the U.S. that has been federally adopted as an Outstanding National Resource Water, Lahontan RWQCB has taken the position that chemical treatment to control invasive aquatic weeds is not justified at this time and other non-chemical means of control should be explored. Currently, the only efforts to control

Eurasian watermilfoil have been mechanical harvesting in the Tahoe Keys to clear areas for boat traffic. This method, however, is likely one of the contributing factors to the increased spread watermilfoil in Lake Tahoe.

In 2005, SLC funded and implemented a pilot project in Emerald Bay to examine control methods outside of the Tahoe Keys. The methods included diver-assisted hand and suction removal in the infested portions of Emerald Bay. The initial effort had limited success because the work was conducted too early in the season (late May). Many plants were not observed and emerged later in the season following the removal efforts. Follow-up surveys in the fall, however, found that areas where plants were removed previously were free of Eurasian watermilfoil. Removal activities in Emerald Bay will continue in 2006 and will be expanded to include an infestation in one of the smaller south shore marinas.

The Tahoe Resource Conservation District (TRCD) is currently applying for an approximate \$500,000 multi-year grant (2007-2010) to survey and remove invasive aquatic weeds throughout Lake Tahoe using the methodology of the pilot project.

Lessons: The initiative of one agency to fund and implement efforts to remove an invasive weed in a sensitive environment like Lake Tahoe through a pilot removal project has encouraged other key agencies (e.g. TRPA and TRCD) to increase their role in the management of invasive aquatic weeds in Lake Tahoe. This has expanded participation and increased cooperation within the existing Lake Tahoe Basin Weed Coordinating Group and led to the formation of an Aquatic Weed Subcommittee.

Background Studies:

Lahontan RWQCB. 2002. Fact Sheet: *Control of the invasive aquatic weed Eurasian Watermilfoil in Lake Tahoe*. South Lake Tahoe, California.

University of Nevada Cooperative Extension. 2002. Fact Sheet: *Eurasian watermilfoil*. FS-02-09. Reno, NV.

Walter, K. 2000. *Ecosystem effects of the invasion of Eurasian watermilfoil (Myriophyllum spicatum) of Lake Tahoe, CA-NV*. M.S. Thesis in Ecology, University of California, Davis.

For more information and contacts on some of these case studies, see Appendices B-D.

OTHER AIS SPECIES OF CONCERN

The following is a representative, rather than comprehensive, list of AIS species not previously mentioned in this report. Some are already here in California and widespread, some are fairly limited in their distribution and some are yet to arrive. The list is merely meant to convey some of the variety of challenges that must be addressed by state management programs. Full scientific names appear in the "Species Names" section of the introductory pages of this plan.

African clawed frog: Shipped around the globe for use in human pregnancy testing during the 1940s and 1950s, populations of African clawed frogs have been introduced into parts of Europe, North America, and South America. Although its impacts to native fauna have undergone little scrutiny, this voracious and prolific frog has shown a remarkable capacity to colonize a broad range of aquatic habitats. In southern California, it occupies more than a 300-mile long range through seven counties. In 2003, the African clawed frog was found in a pond at Golden Gate Park in San Francisco.

Asian swamp eel: The swamp eel is a fish found in brackish and fresh waters from South America, Africa, and India east to Australia. U.S. populations have been found in Hawaii, Florida and Georgia. It is a voracious predator that poses a threat to native frogs, fish, and aquatic insects. The Asian swamp eel has the ability to live out of water for a considerable length of time, allowing it to move from one body of water to another. The Asian swamp eel was most likely introduced through the Asian food market and/or as an aquarium pet later released. There are no known populations in California.

Bullfrog: The North American bullfrog was introduced to California in the early 1900s. A voracious predator, the bullfrog feeds on snakes, worms, insects, crustaceans and other frogs and tadpoles. The female can lay as many as 20,000 eggs in a single breeding season. The bullfrog may be having impacts on native frogs, such as the red-legged frog and has also been implicated as a leptospirosis vector and may pose a threat to human health.

Channeled apple snail: In the United States, this South American apple snail has invaded the southern states of Florida, North Carolina, Texas and central Ohio. There have been reports of at least two populations in California. The apple snail is a common aquarium snail also cultured for sale to restaurants, making its spread through these pathways likely. It has a voracious appetite and will eat most types of vegetation. In Hawaii, the apple snail is considered to be problematic in some natural and agricultural wetlands, most notably in the taro fields which play an important role in Hawaiian culture. The snail's potential as a rice pest as well as a pest of natural wetland ecosystems has spurred the USDA to list them as a high priority threat should they spread or be introduced more widely.

Golden Mussel: A freshwater mussel native to the rivers and streams of China and southeast Asia, the golden mussel was first found in the Americas in 1991, at the mouth of Argentina's Rio de la Plata. It has subsequently spread up the river basin into Uruguay, Paraguay and Brazil. The first colonies are thought to have arrived as larvae in the ballast water of shipping vessels. Like its relative the zebra mussel, the golden mussel readily colonizes hard surfaces including logs and silt, colonies of other bivalves, walls, and piers. Because it settles on floating vegetation, fouls boat hulls and fishing equipment, and can survive for more than 120 hours out of water, it is easily transported to new waterways. Though primarily aquatic, the golden mussel also tolerates slightly brackish waters. It has been found in aggregations of more than 80,000 mussels per square meter. At such high densities, these filter feeders can deplete local waters of plankton and starve or suffocate native filter feeders. Golden mussel infestations can also clog or foul and cooling pipes, intake screens and other aquatic machinery.

Green sunfish: The green sunfish was mistakenly introduced to California from the Midwest in the late 1800s to early 1900s. Green sunfish spawn in shallow waters and have enormous reproductive potential. They compete with native fishes by feeding on insects and small fish and are adaptable to varying lake conditions and climates.

New Zealand mudsnail: Native to freshwater lakes and streams of New Zealand, this snail has spread to six Western states, reaching California's Owens River in the Eastern Sierra in 1999. Since then, it has spread up and down the Owens River as well as into seven other sites scattered throughout Northern California and to multiple sites in southern California. The snail's tight-fitting operculum permits it to survive out of water in damp conditions for several weeks. It likely hitchhiked into California within waders or other equipment used in infested streams. The New Zealand mudsnail has a prodigious reproductive capacity, competes with native mollusks for resources, and offers virtually no nutritional value to aquatic predators. Population levels in California's Putah Creek have been estimated excess of 100,000 snails per square meter. To date, limited research has documented decreases in native macroinvertebrate populations in several rivers where the mudsnail has invaded.

Northern Pacific seastar: Native to the coasts of northern China, Korea, Russia and Japan, this five-armed seastar has spread to many other countries. Its arrival has been linked to ballast water discharges. It is a voracious predator, attacking fleshy organisms such as shellfish. Able to detect food from a distance, it digs shallow pits into the seabed to extract prey. The northern Pacific seastar was the focus of extensive eradication efforts by the Australian government in the mid-1990s and remains on their watch list because of the threat it poses to shellfish production.

Saltcedar (Tamarisk): Saltcedar is native to southeastern Europe and much of central Asia and was introduced to the United States as a landscape ornamental and soil stabilizer. In California, it occurs in the southern Klamath Ranges, Central Valley, eastern Sierra Nevada, Tehachapi Mountains, western Transverse Ranges, South Coast deserts to over 6,000 ft in elevation (DiTomaso and Healy 2003), and the southeastern corner of the state. It is now the dominant plant in the riparian forests of the lower Colorado River. Saltcedar is able to colonize small stream channels where it traps sediments and alters the hydrology. True to its name, the tree concentrates salts in its leaves, and when the leaves drop, local soil salinities may increase. Saltcedar's ability to colonize degraded river systems has allowed it to grow in places where cottonwood and other native riparian vegetation may not. Yet its presence also offers cover, shade and nesting habitat to the endangered southwestern willow flycatcher and other native animal species.

Salvinia: Native to tropical South America, Salvinia Complex consists of four closely-related, free-floating aquatic fern species that can be difficult to distinguish from one another. Giant salvinia is considered one of the world's worst aquatic pests: in favorable environments, plants may double in volume within a week. Giant salvinia forms extensive mats that can completely cover water surfaces, shadowing out native plants, reducing available dissolved oxygen, and creating large amounts of decaying plant material. It can also clog water intakes, interfering with irrigation, drainage and electric power generation. Its arrival in the U.S. has been linked to commercial nurseries and pet stores, where it is sold for ornamental ponds and aquariums. Giant salvinia tends to spread locally because the plants adhere to boats, wheels, and recreational gear entering infested waters. It reproduces so rapidly that infestations quickly become impossible to eradicate. Giant salvinia mats may grow up to three feet thick, hindering the effectiveness of chemical controls. In California, giant salvinia populations have naturalized in the Colorado River drainage and have invaded some canals in the Sonoran Desert and San Luis Obispo County (DiTomaso and Healy 2003). It has also been detected in two ponds in San Diego County.

Northern snakehead: The northern snakehead is a fish native to China that was most likely imported from Asia to the United States as a food fish. It is also sold in the aquarium trade. It can be found in a variety of habitats, and can breathe air with a bladder that works like a primitive lung. The northern snakehead is a voracious predator with no natural enemies. It disrupts native aquatic ecosystems and transmits diseases and parasites, including several species that can infect humans. Its impact on local economies dependent on fishing and other related resources is significant. All 28 species of snakehead are on the federal list of injurious wildlife species, and their importation and transportation across state lines is illegal. See also federal risk assessment at http://fisc.er.usgs.gov/Snakehead_circ_1251/html/risk_assessment_process.html.

Waterlettuce: Waterlettuce is a floating aquatic plant native to South America and is considered to be one of the worst weeds in subtropical and tropical regions of the world. Under optimal environmental conditions, waterlettuce can double its population size in less than three weeks. Seed production makes this plant resilient to adverse environmental conditions such as drought. Waterlettuce populations often form large, impenetrable floating mats, limiting boat traffic, recreation, flood control and wildlife use. It is a popular species for pond landscaping and is frequently sold through nursery mail order catalogs and on the Internet. In California, it has only been reported from the eastern Sonoran Desert (Colorado River drainage), but its range is expected to expand (DiTomaso and Healy 2003).

Paleyellow Iris (Yellowflag Iris): A hearty perennial that grows from tuberous rhizomes, yellowflag iris can grow to 5 feet tall. It is a European native that has adapted well to conditions throughout the U.S., where it can now be found in at least 40 states. It typically grows in wetlands, along river and stream banks, in irrigation ditches and on the margins of lakes and ponds. It was first found in California in the 1970s. It now occurs in the San Francisco Bay region, southern San Joaquin Valley, Central Coast, and South Coast (DiTomaso and Healy 2003). When consumed in large quantities, paleyellow iris can be toxic to livestock. A resinous substance from the leaves and rhizomes can irritate the skin of those removing the rhizomes by hand. Pulling the rhizomes can cause extensive damage to the substrate, inviting the establishment of other unwanted plants. Control techniques such as burning are not recommended because the rhizomes re-sprout. Cutting followed by herbicide applications may be the best method to control this plant.

9. LITERATURE CITED

- Anderson, CD. "TBT Free Antifoulings and Foul Release Systems." www.international-marine.com/antifoulings/TBT_FreeAF_TechPaper.pdf.
- Anderson, LWJ. 2005. "California's Reaction to *Caulerpa taxifolia*: A Model for Invasive Species Rapid Response Actions." *Biological Invasions* 7 (6): 1003-1016.
- Barrett, EM. 1963. "The California Oyster Industry." *Department of Fish and Game Bulletin* 123: 1-103.
- Bolton, T and WM Graham. 2006. "Jellyfish on the Rocks: Bioinvasion Threat of the International Trade in Aquarium Live Rock." *Biological Invasions*, 8 (4): 1387-3547.
- Bergquist, Lee. 2007 "Fighting a fish killer: DNR to instill new rules to combat virus believed to be in Lake Michigan". JS Online. The Milwaukee Journal Sentinel. Posted April 1, 2007 <http://www.jsonline.com/story/index.aspx?id=585050>.
- California Department of Fish and Game, Office of Spill Prevention and Response (DFG/OSPR). 2002. "A survey of non-indigenous aquatic species in the coastal and estuarine waters of California." Submitted to the California Legislature as required by the Ballast Water Management Act of 1999.
- California Department of Food and Agriculture and California Invasive Weed Awareness Coalition. 2005. "California Noxious & Invasive Weed Action Plan." www.cdfa.ca.gov/phpps/ipc/noxweedinfo/noxweedinfo_hp.htm.
- Carlton, JT and JB Geller. 1993. "Ecological roulette: The Global Transport of Nonindigenous Marine Organisms." *Science* 261: 78-82.
- Carlton, JT. 2001. "Introduced Species in U.S. Coastal Waters: Environmental Impacts and Management Priorities." Pew Oceans Commission, Arlington, VA.
- Chapman, DJ. 2005. "Controlling Undaria and invasive kelps through management of the gametophyte." *California Sea Grant College Program Research Completion Reports*, University of California, San Diego, Paper Coastal05_03. http://repositories.cdlib.org/csgc/rcr/Coastal05_03/.
- Cohen, AN, Director Biological Invasions Program, S.F. Estuary Institute, Oakland, CA. Email communication December 15, 2006.
- Cohen, AN and JT Carlton. 1995. "Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta." U.S. Fish and Wildlife Service.
- Cohen, AN and JT Carlton. 1998. "Accelerating Invasion Rate in a Highly Invaded Estuary." *Science* 279: 555-558.
- Cohen, AN and A Weinstein. 1998. "The Potential Distribution and Abundance of Zebra Mussels in California." San Francisco Estuary Institute.
- Daehler, CC and DR Strong. 1997. "Hybridization between introduced smooth cordgrass (*Spartina alterniflora*; *Poaceae*) and native California cordgrass (*S. foliosa*) in San Francisco Bay, California, USA". *American Journal of Botany* 84(5): 607-611.

Daehler, CC, CK Antilla, DR Ayres, DR Strong and JP Baily. 1999. "Evolution of a new ecotype of *Spartina alterniflora* in San Francisco Bay, California, USA." *American Journal of Botany* 86, 543-544.

DiTomaso, JM and EA Healy. 2003. "Aquatic and Riparian Weeds of the West." Sponsored by the California Weed Science Society. University of California, *Agriculture and Natural Resources. Publication 3421*.

Falkner, M, L Takata and S Gilmore. 2006. "Performance Standards for Ballast Water Discharges in California Waters." California State Lands Commission, Marine Facilities Division.

Falkner, M and L Takata, S Gilmore & N Dobroski. 2007. *2007 Biennial Report on the California Marine Invasive Species Program*. California State Lands Commission.

Feyrer, F, M Nobriga and T Sommer. In revision. "Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, U.S.A."

Fisheries Global Information System. "Species Fact Sheet: *Undaria pinnatifida*." Web page www.fao.org/figis/servlet/species?fid=2777. Accessed January 1, 2007.

Fofonoff, PW, GM Ruiz, B Steves and JT Carlton. 2003. "In ships or on ships? Mechanisms of transfer and invasion for non-native species to the coasts of North America." pp. 152-181. In GM Ruiz and JT Carlton (eds.) *Invasive species: Vectors and Management Strategies*. Island Press, Washington, DC, 2003.

Gonzalez, JA and LT Johnson (eds.). 2005. "Managing Hull Transport of Aquatic Invasive Species: Proceedings of May 11, 2005 Workshop in San Francisco, CA." *California Sea Grant College Program Report No. T-059*.

Grosholz, ED and GM Ruiz. 1995. "Spread and potential impact of the recently introduced European green crab, *Carcinus maenus*, in central California." *Marine Biology* 122:239-247.

Grosholz, ED, GM Ruiz, CA Dean, KA Shirley, JL Maron, and PG Connors. 2000. "The impacts of a nonindigenous marine predator in a California bay." *Ecology* 81 (5): 1206-1224.

Hewitt, CL. 2002. "The distribution and diversity of tropical Australian marine bioinvasions." *Pacific Science* 56: 213-222.

Hewitt, CL, ML Campbell, RE Thresher, RB Martin, S Boyd, BF Cohen, DR Currie, MF Gomon, MJ Keough, JA Lewis, MM Lockett, N Mays, MA McArthur, TD O'Hara, GCB Poore, DJ Ross, MJ Storey, JE Watson and RS Wilson. 2004. "Introduced and cryptogenic species in Port Phillip Bay, Victoria, Australia." *Marine Biology* 144 (1): 183-202.

Hieb, K. 2005. "2005 Annual Status and Trend Report – Common Crabs of the San Francisco Estuary." Interagency Ecological Program for the San Francisco Estuary, *Spring 2006 IEP Newsletter* in press.

Hoyer, MV and DE Canfield, Jr, editors. 1997. *Aquatic Plant Management in Lakes and Reservoirs*. Prepared by the North American Lake Management Society (P.O. Box 5443, Madison, WI 53705-5443) and the Aquatic Plant Management Society (P.O. Box 1477, Lehigh, FL 33970) for U.S. Environmental Protection Agency, Washington DC.

Kildow, J and CS Colgan. 2005. "California's Ocean Economy: Report to the Resources Agency, State of California." National Ocean Economics Program. noep.csUMB.edu/Download/.

Kovalak, WP, GD Longton and RD Smithee. 1993. "Infestation of power plant water systems by the zebra mussel (*Dreissena polymorpha*)." pp. 359–380. In TF Nalepa and DW Schloesser

- (eds.) Zebra mussels: Biology, impact and control. Lewis Publ., Boca Raton, FL.
- Lafferty, KD and AM Kuris. 1996. "Biological Control of Marine Pests." *Ecology* 77 (7): 1989-2000.
- Leslie, G. 2007. Program Supervisor, Pest Exclusion, Exterior Program, California Department of Food and Agriculture. Email communication January 8, 2007.
- Leson & Associates. 2005. "Use of Imazapyr Herbicide to Control Invasive Cordgrass (*Spartina* spp.) in the San Francisco Estuary: Water Quality, Biological Resources, and Human Health and Safety." Prepared for the San Francisco Estuary Invasive Spartina Project/State Coastal Conservancy, Oakland, California. May 4, 2005.
- Leung B, DM Lodge, D Finnoff, JF Shogren, MA Lewis and G Lamberti. 2002. "An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species." *Proceedings of the Royal Society B: Biological Sciences* 269 (1508): 2407-2413.
- Lodge DM, S Williams, H MacIsaac, K Hayes, B Leung, S Reichard, R Mack, P Moyle, M Smith, D Andow, JT Carlton and A McMichael, 2006. "Biological Invasions: Recommendations for U.S. Policy and Management." Position paper of the Ecological Society of America. See also Appendix F.
- Lovell, SJ and SF Stone. 2005. "The Economic Impacts of Aquatic Invasive Species: A Review of the Literature." National Center for Environmental Economics, Working Paper Series, Publication 2005-02, January 2005. U.S. Environmental Protection Agency, Washington, DC.
- Maryland Sea Grant Zebra Mussel website. Accessed September 2003. <http://www.mdsq.umd.edu/issues/restoration/non-natives/zebramussel/>.
- McDonald, PS, GC Jensen and DA Armstrong. 2001. "The competitive and predatory impacts of the nonindigenous crab *Carcinus maenas* (L.) on early benthic phase Dungeness crab *Cancer magister* Dana." *Journal of Experimental Marine Biology and Ecology* 258:39-54.
- McLaughlin, L. Non-Native Invasive Species Program, USFWS, Stockton, CA. August 29, 2006. E-mail to Julie Horenstein, Invasive Species Program, Habitat Conservation Planning Branch, DFG and other members of California Interagency Noxious and Invasive Plant Committee.
- Merkel & Associates, Inc. 2006. *Final report on eradication of the invasive seaweed *Caulerpa taxifolia* from Agua Hedionda Lagoon and Huntington Harbour, California*. Prepared for the Steering Committee of the Southern California Caulerpa Action Team.
- Messer, DF. personal communication. August 2007.
- Minnesota Sea Grant website. Accessed September 2003. <http://www.seagrants.umn.edu/ais/>.
- Moyle, PB. 2002. Inland fishes of California. University of California Press, Berkeley, CA.
- National Council for Science and the Environment. 1999. "Harmful Non-Native Species: Issues for Congress." Washington, DC. <http://ncseonline.org/NLE/CRSreports/Biodiversity/biodv-26.cfm>.
- National Invasive Species Council. 2001. "National Invasive Species Management Plan: Meeting the Invasive Species Challenge". <http://www.invasivespeciesinfo.gov/council/nmp.shtml>.
- National Invasive Species Council. 2005. "Focus Group Conference Report and Pathways Ranking Guide (June-August 2005)." pp. 1-66. National Invasive Species Council/Aquatic Nuisance Species Task Force/NISC Prevention Committee Pathways Work Team. <http://www.anstaskforce.gov/Documents/2006%20Pathways%20Guide.pdf>.

- Pacific Merchant Shipping Association. 2004. "Trade and the Economy. Economic Impacts. California." (fact sheet). http://www.pmsaship.com/economic_impact.html.
- Parsons, MG. 1998. "Flow-through ballast water exchange." *Society of Naval Architects and Marine Engineers Transactions* 106: 485-493.
- Patten, K. 2002. "Smooth Cordgrass (*Spartina alterniflora*) Control with Imazapyr", *Weed Technology* 16, pp. 826-832.
- Patten, K. 2003. "Persistence and non-target impact of imazapyr associated with smooth cordgrass control in an estuary", *Journal of Aquatic Plant Management* 41, pp. 1-6.
- Peterson, H. 1996. "Potamocorbula amurensis Spatial Distribution Survey." *IEP Newsletter Winter 1996*: 18-19. California Dept. of Water Resources, Sacramento, CA. www.iep.water.ca.gov/report/newsletter/1996winter/.
- Pimentel, D, L Lach, R Zuniga, and D Morrison. 2000. "Environmental and Economic Costs of Nonindigenous Species in the United States." *Bioscience* 50: 53-65.
- Pimentel, D. 2003. "Economic and Ecological Costs Associated with Aquatic Invasive Species." pp. 3-5. In K Wakefield and A Faulds (eds.) *Proceedings of the Aquatic Invaders of the Delaware Estuary Symposium*, Malvern, Pennsylvania, May 20, 2003. <http://www.sgnis.org/publicat/proceed/aide/pime2003.htm>.
- Pimentel, D, R Zuniga and D Morrison. 2005. "Update on the environmental and economic costs associated with alien invasive species in the United States." *Ecological Economics* 52 (3): 273-288.
- Posey, MH. 1988. "Community Changes Associated with the Spread of an Introduced Seagrass, *Zostera japonica*." *Ecology* 69 (4):974-983.
- Ruiz, GM, PW Fofonoff, JT Carlton, MJ Wonham and AH Hines. 2000. "Invasion of Coastal Marine Communities in North America: Apparent Patterns, Processes and Biases." *Annual Review of Ecology and Systematics* 31: 481-531.
- Sanctuary Integrated Monitoring Network. "Monitoring and Management of the Invasive Alga *Undaria pinnatifida*." Web page Accessed January 1, 2007. http://www.mbnms-simon.org/sections/rockyShores/project_info.php?pid=100184&sec=rs.
- San Francisco Estuary Invasive Spartina Project. 2004-2006 Studies covering site specifics, tidal marsh carrying capacity for clapper rails, rail distribution, field operations and an aquatic pesticide application plan, as well as EIRs and endangered species consultations, among other topics. http://www.spartina.org/project_documents/.
- Sea Grant. 1998. "Bio-invasions: Breaching Natural Barriers." Washington Sea Grant. University of Washington, Seattle, WA. <http://wsg.washington.edu/communications/online/bioinvasions/bioinvasions.pdf>.
- Stewart, AR, SN Luoma, CE Schlekot, MA Doblin and KA Hieb. 2004. "Food Web Pathway Determines How Selenium Affects Aquatic Ecosystems: A San Francisco Bay Case Study." *Environmental Science & Technology* 38 (17): 4519-4526.
- Takata L, M Falkner and S Gilmore. 2006. "California State Lands Commission Report on Commercial Vessel Fouling in California: Analysis, Evaluation, and Recommendations to Reduce

Nonindigenous Species Release from the Non-Ballast Water Vector." California State Lands Commission, Marine Facilities Division.

Thompson, JK. 2005. "One Estuary, One Invasion, Two Responses: Phytoplankton and Benthic Community Dynamics Determine the Effect of an Estuarine Invasive Suspension-Feeder." pp. 291-316. In RF Dame and S Olenin (eds.), *The comparative roles of suspension-feeders in ecosystems*. NATO Science Series. IV. *Earth and Environmental Sciences* 47: 1-10.

Thresher, RE. 1999. "Key threats from marine bioinvasions: A review of current and future issues." pp. 24-34. In J Pederson (ed.) *Marine Bioinvasions: Proceedings of the First International Conference*, January 24-27. MIT Sea Grant. MIT-W-99-004.

U.S. Coast Guard. 2001. "Report to Congress on the Voluntary National Guidelines for Ballast Water Management." Washington, DC.

U.S. Environmental Protection Agency. 2005. "Overview of EPA Authorities for Natural Resource Managers Developing Aquatic Invasive Species Rapid Response and Management Plans." EPA842-B-05-002 December 2005.

Whitlatch, RB, RW Osman, A Frese, R Malatesta, P Mitchell and L Sedgewick. 1995. "The ecology of two introduced marine ascidians and their effects on epifaunal organisms in Long Island Sound." pp. 29-48. In N Balcom (ed.), *Proceedings of the Northeast Conference on Non-Indigenous Aquatic Nuisance Species*. 1997. Connecticut Sea Grant College Program. CT-SG-9504.

Wilcove, DS, D Rothstein, D Dubow and J Phillips. 1998. "Quantifying Threats to Imperiled Species in the United States." *Bioscience* 48 (8): 607-615.

Zhang, F and M Dickman. 1999. "Mid-ocean exchange of container vessel ballast water. 1: Seasonal factors affecting the transport of harmful diatoms and dinoflagellates." *Marine Ecology Progress Series* 176: 243-251.

**CALIFORNIA
AQUATIC INVASIVE SPECIES
MANAGEMENT PLAN**

August 2007

Appendices

A: DRAFT CALIFORNIA RAPID RESPONSE PLAN.....2
B: FEDERAL AUTHORITIES, LEGISLATION & AGENCIES.....26
C: STATE AUTHORITIES, LEGISLATION & AGENCIES.....37
D: OTHER AIS INTERESTS: COORDINATING COMMITTEES, EDUCATIONAL
INITIATIVES & SPECIAL INTEREST GROUPS46
E: AIS PLAN DEVELOPMENT & PROCESS53
F: EXECUTIVE SUMMARY OF BIOLOGICAL INVASIONS:
RECOMMENDATIONS FOR U.S. POLICY AND MANAGEMENT,
POSITION PAPER OF ECOLOGICAL SOCIETY OF AMERICA.....71
G: LIST OF REGULATED SPECIES IN CALIFORNIA74

APPENDIX A:
DRAFT
AUGUST 2007

RAPID RESPONSE PLAN

FOR AQUATIC INVASIVE SPECIES IN CALIFORNIA



Prepared by:

California Department of Fish & Game
Habitat Conservation Branch
The Invasive Species Program

**RAPID RESPONSE PLAN
FOR AQUATIC INVASIVE SPECIES IN CALIFORNIA
TABLE OF CONTENTS**

I. Introduction4

II. Legal Authority for Rapid Response5

III. Rapid Response Procedure.....6

IV. Planning for Rapid Response16

V. Supporting Materials

 Form 1. Suspect AIS Sighting Report.....21

 Form 2. AIS Alert Report.....22

VI. References.....23

VII. Interagency Agreements (attached following approval)

I. INTRODUCTION

Goal: The purpose of this plan is to provide a framework for an effective rapid response to the discovery of any aquatic invasive species (AIS) that is new to California, or of a population of established AIS that is outside of its known distribution in California.

In this document, "rapid response" means that soon after an aquatic species new to the State of California or a specific region of the state is discovered, 1) the state will make a determination of whether it is potentially detrimental and/or invasive and 2) if that is the case, the state will develop and implement a course of action. This also would apply to AIS that are discovered in an adjacent state in a waterway or lake that ultimately enters California.

Possible courses of action for newly discovered AIS may include an effort to eradicate the species, control its spread, prevent future introductions, minimize or mitigate the damage it causes, or study it further before any other action is taken. Rapid response is the second line of defense after prevention to minimize the negative impacts of AIS on the environment and economy of California. Once non-native invasive species become widespread, efforts to control them are typically more expensive and less successful than rapid response measures. The damage caused by an AIS that becomes widespread, and the actions that are taken to control it, may be more harmful to the environment than a successful rapid response.

California does not have an official rapid response plan for AIS, does not have a designated funding source for providing a rapid response, and no agency is designated with overall responsibility for AIS management. For this reason, it is unknown whether the necessary elements to conduct a rapid response operation will come together when the need arises. If the commitment, expertise and funding fail to coalesce, the state could be faced with substantial environmental and economic consequences caused by AIS infestations. Even if an ad hoc rapid response effort is made, the following consequences may result:

1. The effort may be compromised by less than adequate staff levels, authority and funding to carry out necessary actions.
2. Staff assigned on an ad hoc basis are less likely to have received training in advance that would help them function as effectively and efficiently as possible in this situation (e.g. Incident Command System training).
3. The effort may be compromised indirectly by staff in charge of the ad hoc effort spending their time trying to secure staff and funding for the response instead of leading the response itself.
4. The effort may not have the level of organization and accountability to be gained from following an official plan.
5. Some governmental and non-governmental entities may be less cooperative with an ad-hoc response than they would be if the response is a standard procedure that is based on official agency agreements.
6. Any resulting confusion could lead to a perception that public funds are mismanaged, that environmental regulations are not being followed, or that the interests of community leaders have been disregarded.

To address the threat posed to California habitats by new AIS introductions, and the lack of an organized plan and funding to address this threat, Chapter 6 (Task 4A1) of the California Aquatic Invasive Species Management Plan (CAISMP) calls for the development and implementation of a rapid response plan. The CAISMP was completed by the California Department of Fish and Game (DFG) in 2007. The CAISMP acknowledges that rapid response

to AIS in California may often require cooperation among a variety of local, state and federal agencies and organizations, and that formal agreement on a plan, in advance of need, increases the likelihood of responding in an effective manner.

This draft Rapid Response Plan will be available for review by agencies and organizations that are likely to have an interest in rapid response. DFG's Invasive Species Program will revise the plan based on the comments received. The goal is to arrive at a plan that can be the basis for agreements to cooperate on rapid response to AIS. In order to finalize, fund and implement the plan, it is hoped that cooperating agencies will assign staff to participate. DFG Invasive Species Program staff will provide coordination for the interagency activities called for in the agreement(s).

Please note that the procedure section of this plan (Section III) is followed by the planning section (Section IV). The order of these sections is deliberate and meant to emphasize that the objective is to have a working product. Both the procedure and planning sections of this document discuss the need to collect data to evaluate the feasibility and success of the plan. This rapid response plan is meant to fit into an adaptive management strategy where evaluation can lead to improved procedures.

It is not possible to plan proactively for every species that might become a nuisance in state waters, hence the need for this generic plan. It stands to reason, however, that a generic plan cannot be implemented as efficiently as a species- or location-specific plan. Therefore, rapid response plans for individual species or related groups of species at high risk of being introduced and becoming destructive should be formulated. This step is called for in Action 4A3 of the CAISMP.

To effectively protect state aquatic habitats from the impacts of AIS, California needs to develop and implement a comprehensive AIS early detection and reporting plan. This document does not attempt to address the issue of early detection, nor provide a detailed discussion of mechanisms for reporting AIS. It focuses on what happens after detection of a suspect AIS. Since some early detection and reporting of AIS already occurs, a rapid response procedure is considered the most immediate need.

II. LEGAL AUTHORITY FOR RAPID RESPONSE

Appendices B and C in the CAISMP provide general information on the federal and state government agencies and regulations involved in the management of AIS. Rapid response activities could potentially require state and/or federal permits, consultations or agreements related to the placement of fill or structures into state and/or federal waters, protection of state or federally listed species, or the protection of other special status plant or animal species. The normal timeline for obtaining permits issued under these laws may critically delay rapid response efforts. A streamlined regulatory permitting process for implementing the Rapid Response Plan will need to be developed and approved by participating agencies. Additionally, permission is necessary to work on private and public properties. Clear protocols need to be developed to avoid misunderstandings or illegal trespassing, while making the process of obtaining access as efficient as possible.

In addition to the laws relevant to AIS discussed in the CAISMP, there are laws that specifically address taking action during an emergency or under special circumstances. These laws can facilitate the implementation of a rapid response procedure. Examples include:

Creation of Emergency Regulations

Under California Government Code Section 11346.1, rulemaking state agencies, departments, commissions, offices and boards can adopt emergency regulations, which can remain in effect for up to 120 days. These are regulations that must take effect immediately for "preservation of the public peace, health and safety or general welfare" and must meet other requirements of that code section. The process for adoption of emergency regulations can be found at the Office of Administrative Law's web site (www.oal.ca.gov/emergency_reg.htm).

The California Department of Food and Agriculture (DFA) has specific statutory authority to establish quarantines to protect the state's agricultural industry from pests (Food and Agriculture Code Section 5301). If an AIS is discovered that has the potential to severely damage crops, water delivery, or flood control systems that support agriculture, DFA can invoke their authority to establish a quarantine area.

According to Section 660 of the Harbor and Navigation Code, any entity, local or state, authorized by law to adopt rules or regulations that govern matters relating to boats or vessels may adopt emergency measures within their jurisdiction as long as they are not in conflict with the general laws of the state relating to those matters. The emergency rules or regulations can be effective for up to 60 days and must be submitted to the Department of Boating and Waterways (DBW) on or before their adoption. DBW can authorize these emergency rules or regulations to be in effect for over 60 days if it is deemed necessary.

Use of a Pesticide Outside of its Registered Use

When dealing with species that are new to California, the technical experts participating in a rapid response incident may determine that the best solution is to use a pesticide outside of its registered use or to deploy a new end use product. Section 18 of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) allows states to apply to use a pesticide for an unregistered use for a limited amount of time if the EPA determines that emergency conditions exist (<http://www.epa.gov/opprd001/section18>). Under Section 6206 of Title 3 of the California Code of Regulations (CCR), the DFA Director is permitted to apply for a Section 18 exemption when emergency conditions exist. Section 24 of FIFRA authorizes states to register an additional use of a federally registered pesticide or a new end use product to meet a special local need (www.epa.gov/opprd001/24c).

Experimental Unregistered Use of a Pesticide

Section 6260 of Title 3 of the CCR provides the conditions for obtaining a Research Authorization for the experimental use of a pesticide outside of its registered uses. Research Authorizations are administered by the California Department of Pesticide Regulation (DPR).

III. RAPID RESPONSE PROCEDURE

The initial steps in this procedure result in the determination of whether an active response is immediately necessary after a potential invasive species is reported. If immediate action is necessary, and requires more than simple, highly localized measures, resource management staff may decide to implement an incident command system (ICS) response. A set of criteria will be developed to help in this decision making process. Many of the steps listed below are likely to take place simultaneously or overlap to some degree. Examples of these include outreach, rapid assessment, and containment activities. A flow chart showing the general steps of this rapid response procedure is provided as Chart 1.

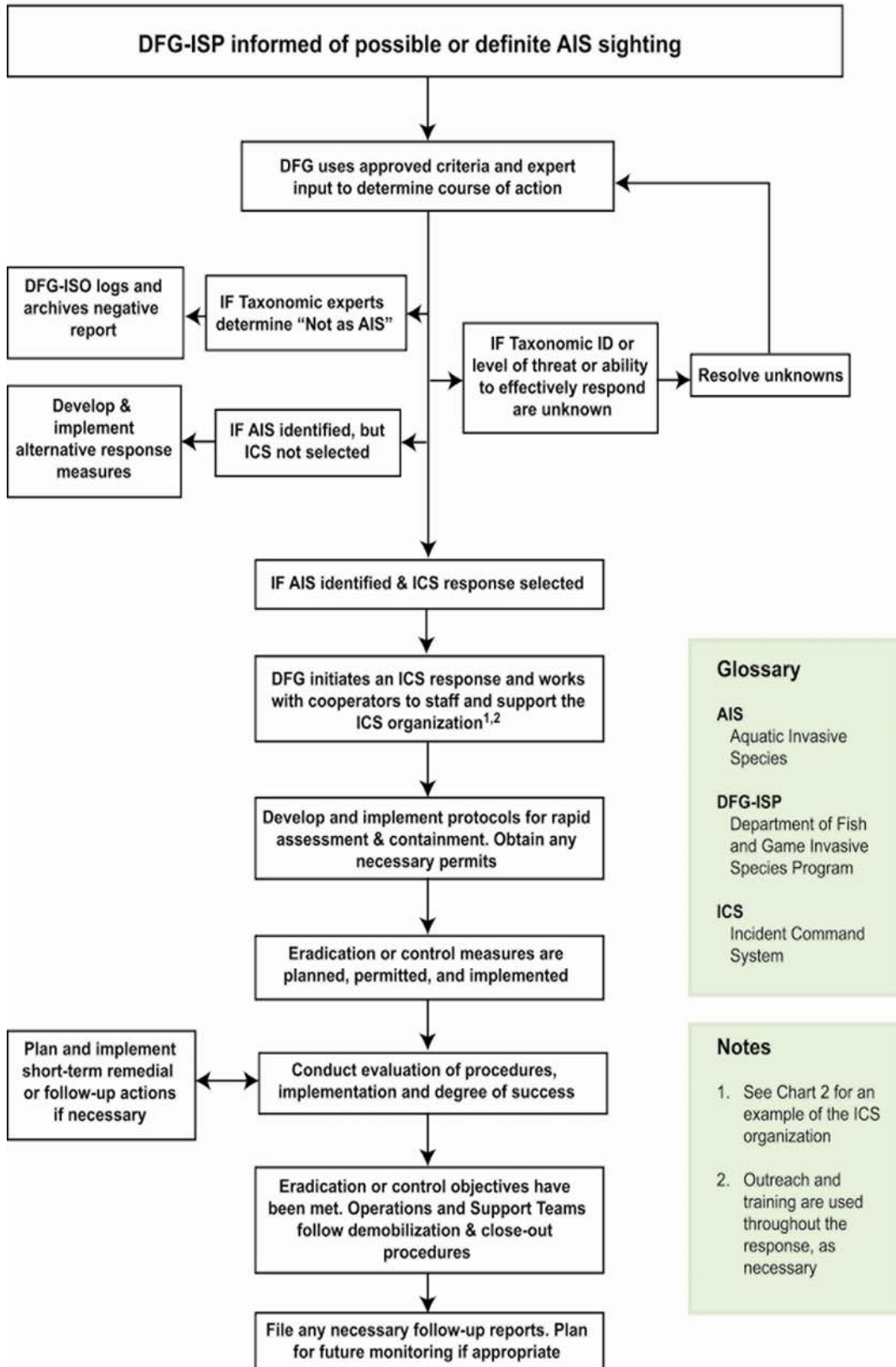
In an ICS response, participants are assigned specific roles in a well-defined hierarchical system that can be expanded or collapsed based on the size and complexity of the incident. The ICS was developed to allow staff from different government agencies and organizations to work

effectively and efficiently together to respond to a natural disaster. Participants essentially check their individual agency identities at the door and participate as members of the ICS organization, dedicated to responding to a particular incident. The system's success relies on participants understanding their role, a clear chain of command and communication, managers having an appropriate span of control, and a standardized process for identifying and communicating objectives, strategies, tasks and deadlines. Because of its proven effectiveness, the ICS has recently been integrated into the National Incident Management System (NIMS). For more information about the principles and features of the ICS go to Lessons 2 and 3 at <http://emilms.fema.gov/ICS100G/index.htm>. To learn more about the integration of ICS into NIMS, please visit www.fema.gov/emergency/nims. An example of how the ICS staff organization scheme has been applied to an AIS rapid response in California is provided in Chart 2.

Optimal use of this system requires that participants be trained in advance per Section IV (Planning) of this document. The Planning Section also discusses the need to develop the finer details of the procedure, the lists and directories that are referred to in the procedure, and the designation of alternates. This last item ensures that none of the positions described in the procedure are ever vacant.

The procedure that will be followed for a given incident may follow the generic plan provided below or be based on a species-specific rapid response plan approved by the participating agencies. As species-specific plans are developed and approved, staff that have been identified as potential responders will be notified of their approval and location on the Internet. Basic information about each species specific plan will be incorporated into AIS rapid response training.

Chart I. DRAFT General Procedure for Rapid Response Following the Detection of an Aquatic Invasive Species Infestation



Glossary

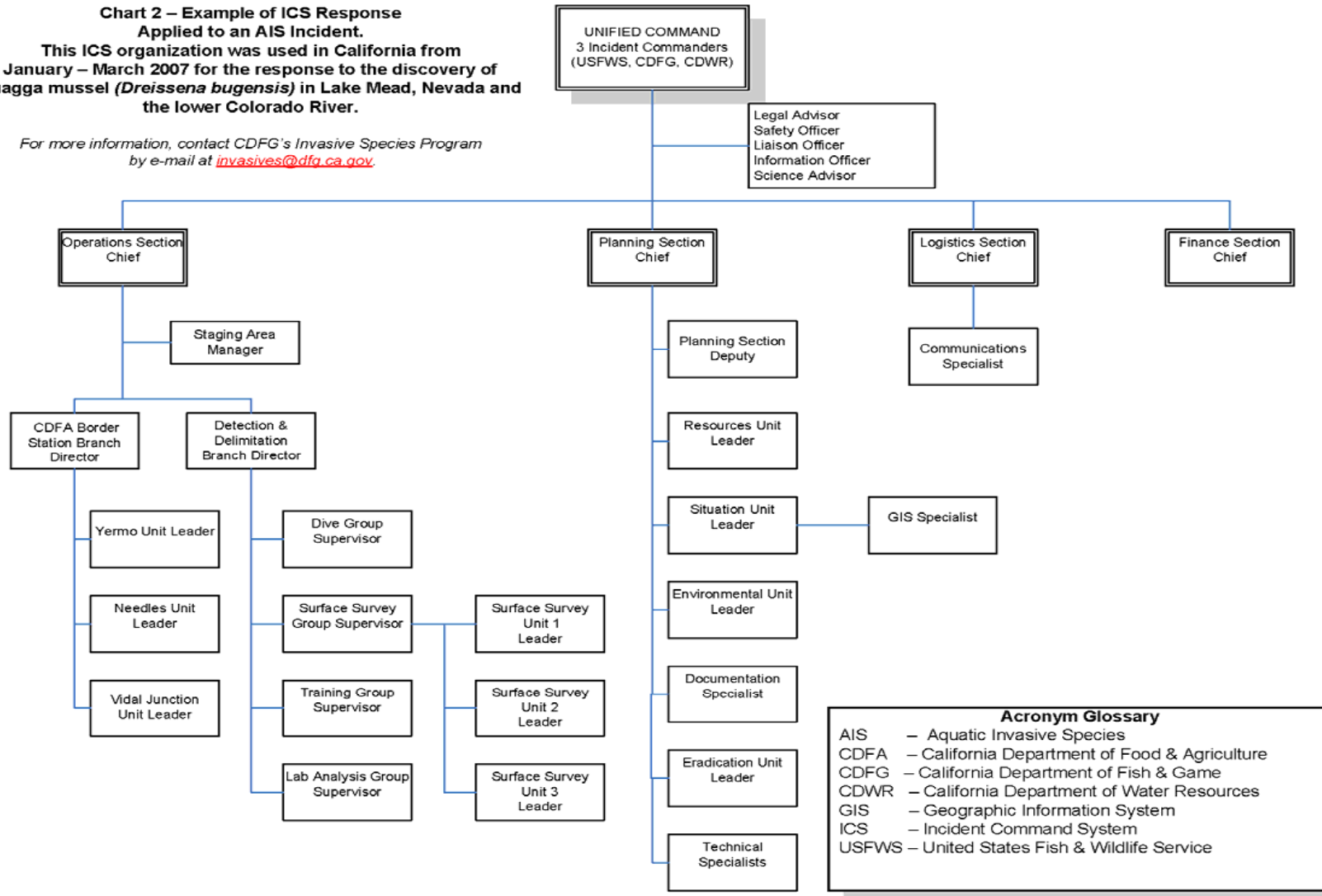
- AIS**
Aquatic Invasive Species
- DFG-ISP**
Department of Fish and Game Invasive Species Program
- ICS**
Incident Command System

Notes

1. See Chart 2 for an example of the ICS organization
2. Outreach and training are used throughout the response, as necessary

Chart 2 – Example of ICS Response Applied to an AIS Incident.
 This ICS organization was used in California from January – March 2007 for the response to the discovery of quagga mussel (*Dreissena bugensis*) in Lake Mead, Nevada and the lower Colorado River.

For more information, contact CDFG's Invasive Species Program by e-mail at invasives@dfg.ca.gov.



17-STEP RAPID RESPONSE PROCEDURE

Step 1. Identify species and notify authorities

- a. Sighting Report: There are three ways in which DFG is likely to receive a report of an AIS sighting.
 1. Either a sighting is reported to DFG via a hotline phone number or e-mail address (Invasives@dfg.ca.gov), and catalogued on *RR Form 1: Suspect AIS Sighting Report* (see Section V).
 2. Staff from another agency or cooperator discovers the AIS and submits the collected information directly to DFG's Invasive Species Program staff.
 3. The initial report is made to one of the federal invasive species reporting systems (e.g. "United States Geological Survey Nonindigenous Aquatic Species Alert System" or the "100th Meridian Initiative") which in turn will alert DFG.
- b. Sighting Transmittal: This initial information is transmitted to the DFG Invasive Species Coordinator (ISC). If there is uncertainty about the identification of the species, the Invasive Species Program staff will work with taxonomic experts to resolve the issue.
- c. For the purpose of documentation, and to assist making a determination of how to proceed following the initial report, the more detailed *RR Form 2: AIS Alert Report* (see Section V) should be completed.
- d. Negative ID: If the identification is negative for AIS no further action is necessary.
- e. Indefinite ID and/or level of threat: If uncertainty remains after initial fact-finding, the DFG Invasive Species staff should continue to work with experts from cooperating agencies and research institutions to determine the status of the species reported and the level of threat.
- f. Positive ID with a high level of threat: If the discovered organism is invasive and in the presence of vectors that could cause its spread to uninfested areas, DFG Invasive Species Coordinator will consult with DFG executive level staff to determine if an ICS response is appropriate.
 1. If the identification is positive, the DFG Invasive Species staff will ensure that a report is sent to the United States Geological Survey Nonindigenous Aquatic Species Alert System (<http://nas.er.usgs.gov/SightingReport.asp>). During the response, the alert system should receive updates on any additional locations of the AIS that are found.
 2. Fill out an Incident Brief Form (ICS Form 201).
 3. ICS forms are available at:
http://training.fema.gov/EMIWeb/IS/ICSResource/ICSResCntr_Forms.htm

Step 2. Activate command-level participants

- a. Incident Command Staff: The executive level DFG staff will work with the Invasive Species Coordinator and executive level staff of cooperating agencies to identify the Incident Command staff. They can utilize the Rapid Response Personnel Directory discussed in the Planning Section of this document.

1. The Incident Commander is the overall supervisor and coordinator for the incident. A detailed description of the responsibilities of an Incident Commander and the other Incident Command officers and General Staff positions, can be found in Lessons 3 and 4 at <http://emilms.fema.gov/ICS100G/index.htm>.
2. Executive level staff and the ISC will decide to pursue a single command response, with one Incident Commander, or a unified command response, with multiple Incident Commanders working as a team. A Unified Command approach is designed to be used in multi-agency or multi-jurisdiction responses.
 - b. Initial Unified Command Meeting: If a unified command approach is used the Incident Commanders in the Unified Command should meet to discuss and concur on important issues prior to starting the first operational period planning meetings.

Step 3. Implement the ICS Planning Cycle

- a. Begin to utilize the ICS planning cycle to document the current status of the response, identify objectives, strategies, specific task assignments and operational period. See http://www.uscg.mil/hq/g-m/mor/media/Chapter_3.pdf for a description of the ICS Planning Cycle.
 1. During every ICS planning cycle, an Incident Action Plan is developed for the following operational period. It contains objectives, safety measures, staff contact information, status of the incident and assignments for each organizational element that will be active during the next operational period. The plan must be approved by the Incident Commander(s).
 - a) The plan is comprised of standard ICS forms that are available in electronic form. Once the initial set of forms is completed, the Incident Action Plan can rapidly be revised and updated.

Step 4. Develop the Organization

- a. Command Post: Establish a command post capable of supporting the space, logistic, communication and other technology needs for managing the operation. It may or may not be a high priority to have the command post located close to the infested site, based on the characteristics of a particular incident. Potential command posts will be listed in the AIS Rapid Response Resource Directory discussed in the Planning Section of this document.
- b. Logistics and Finance: The Logistic and Finance Section Chiefs will establish the fundamental tools and means to run the organization, such as setting up the check-in routine, necessary ICS forms, communication services, spending authorizations, and tracking of resources.
- c. Assemble Organizational Elements: Using the ICS system, develop an organization that is suitable for the size and complexity of the incident.
 1. Directory of Approved Staff: To staff the organizational elements (e.g. sections, branches, units) the Incident Command and upper level General Staff will utilize (but are not limited to) staff directories of people approved to be assigned to rapid response efforts.
 2. ICS training materials suggest that "it is better to initially overestimate the need for a larger organization than to underestimate it, as it is always possible to downsize the organization." (National Wildfire Coordinating Group, 1994, p.3-19).

3. Logistics Section staff will utilize the Resource Directory discussed in the Planning Section of this document in their effort to procure the necessary equipment and supplies among cooperating agencies and organizations during a rapid response procedure.
- d. Consider the need to assemble a science advisory panel that may include experts outside of the ICS organization to provide input on such topics as AIS biology, sampling techniques, eradication or control measures.

Step 5. Safety Plan

- a. The standard ICS organization includes a Safety Officer who reports to the Incident Commander/Unified Command. One of the duties of the Safety Officer is to develop a Safety and Health Plan that assesses potentially hazardous situations that could exist throughout the operation for responders and the public, and outlines the safety measures that should be taken.

Step 6. Outreach

- a. Outreach Plan: The incident's Information Officer develops an Outreach Plan for the incident that addresses short and long-term proactive communication objectives and strategies to be employed with relevant groups such as the media, government agency representatives outside of the ICS response, stakeholders, interest and community groups and the general public.
 1. Develop policy with the Incident Commander(s) and the Liaison Officer regarding protocols for disseminating information.
 2. Besides disseminating information the outreach plan should address obtaining input from stakeholder groups and other interested individuals.
- b. The Media: Typically, the Information Officer is assigned to be the contact person for inquiries from the media.
 1. Typical tasks include preparation of press releases, briefings, public meetings, etc.
 2. The Information Officer reports to the Incident Commander.
- c. Government Agencies: Typically, a Liaison Officer is assigned to be the point of contact for inquiries from government agencies that have an interest in the response.
 1. The Liaison Officer provides relevant updates on the response to representatives from these agencies.
 2. The Liaison Officer reports to the Incident Commander.
- d. Stakeholder and Interest Groups: Outreach to these groups can be crucial, especially if their activities can result in spread of the AIS. Outreach to non-governmental groups needs to be assigned to the Information Officer or the Liaison Officer. A large stakeholder group for a large incident may warrant their own Assistant Liaison Officer or Assistant Information Officer to maximize cooperation from this group and be aware of concerns they may have.
- e. General Public: Assign who will be responsible for responding to inquiries from individual members of the public. Determine whether it is advisable to establish and publicize a toll-free call-in number for the incident.

Step 7. Training

- a. Develop a Training Plan: There is often a need to establish a training branch within the ICS. As the incident begins to unfold, the Training Director will be responsible for working with managerial level staff to assess and find appropriate means to provide the types of training that are needed, both for staff within the ICS and for cooperating agencies, organizations and volunteers.
 - 1. A training manual should be developed that contains any specialized protocols and associated training materials (e.g. survey or decontamination protocols).

Step 8. Regulatory Compliance

- a. The Planning Section is typically responsible for addressing regulatory compliance with environmental laws, with input from the Legal Specialist assigned to the incident. The issues that are most likely to arise are related to water quality and effects on state or federally listed species during survey or control activities.

Step 9. Containment Actions

- a. Take action to prevent the spread of the AIS. Examples of containment actions that might be taken include:
 - 1. Inspections: Working with public and private managers of infested and potentially infested waterbodies and waterways, locate and inspect potentially contaminated facilities, shorelines, boats, vehicles and equipment to the extent possible. Prioritize a list of potential sites that should be inspected. Some of this work is part of the rapid assessment described below.
 - a) Survey boaters about previous and subsequent waterways visited and provide them with information about the AIS problem.
 - b) If regulations allow, require, or otherwise, request that aquatic plant and animal material be removed from the watercraft, motor and trailer and for any remaining water to be drained.
 - c) Request that boats and equipment be rinsed with high pressure or hot water and dried before launching. The time needed for drying is species specific.
 - d) Boats that are found to be contaminated with a legally restricted species per F&G Code Sec. 671 cannot be launched until they are certified by DFG to be decontaminated.
- b. Introductions from Out-of-State: Coordinate with California Department of Food and Agriculture's Border Protection Station Program, federal, and other state and national agencies if the introduction is known to have come from out of state or has potential to have come from out of state.
- c. Prevent Spread from California: Coordinate with federal and state agencies on preventing spread from California into other states (especially states that border CA), Canada or Mexico.
- d. Temporarily quarantine body(ies) of water that contain subject AIS.
 - 1. Establish a quarantine utilizing one of the methods discussed in legal authority section.
 - 2. In addition to sites known to contain the subject AIS, consider whether it is appropriate to quarantine areas where the AIS may have been introduced.

Step 10. Rapid Assessment

- a. Extent of the Infestation: Get a qualitative “snapshot” of the extent of the infestation and identify potential vectors for spreading the AIS.
 1. Planning and Operations Section staff can work together to identify short vs. longer-term information needs and plan how various types of information should be gathered.
 - a) Samples may need to be collected for gathering basic demographic information or more in-depth taxonomic work. Establish protocol for collecting, transporting, and storing samples. Develop appropriate permits for possession and transportation of specimens.
 - b) In addition to noting the presence or absence of the AIS, consider whether it’s appropriate to systematically get some basic information about the habitat at this point, collect samples of substrate or water, etc.
 - c) Determine whether there are known occurrences of, or potential habitat for, state or federally listed species in the area that needs to be surveyed, and whether surveys may require consultation with DFG, the U.S. Fish and Wildlife Service or NOAA Fisheries.
- b. Data collection is typically done by the Operations Section of the ICS, with the Logistics and Finance Sections providing assistance with the procurement of equipment, vehicles, travel, etc.
- c. Impacted Parties: Obtain contact information for pertinent landowners, land managers, holders of water rights, water users and jurisdiction over the body(ies) of water involved. If it is necessary to enter private property to conduct rapid response work, assign an ICS member to obtain permission to enter.

Step 11. Plan Eradication or Control Measures

- a. If appropriate, develop a plan to eradicate the AIS from CA or a control plan to prevent the spread of the AIS. It may not be feasible to finalize the plan during the rapid or ICS phase of the response. Some planning may occur after the ICS is demobilized.
 1. During the assessment phase of the response, the Planning Section can gather and review information on potential eradication or control techniques and confer with experts (Step 4D).
 2. As information is gained from the rapid assessment, and possibly from subsequent detailed sampling, a more refined version of an eradication or control plan can be prepared, discussing the specific measurable objectives, locations and methods for eradication or control, methods for evaluating the effectiveness of the plan, and the potential costs, benefits and impacts.
 3. Conduct any regulatory processes and obtain any regulatory permits that may be necessary prior to implementation of the plan.

Step 12. Implement the Eradication or Control Plan

- a. Implementation of the eradication or control plan may place during the “rapid” part of a response; however, if this is not the case, eradication or control measures might be implemented during a later “post –ICS” phase of the response.
- b. Document implementation of the eradication or control plan. Note any deviations from the plan and why those occurred.

Step 13. Prevent Reinfestation

- a. Develop specific recommendations for actions that can be recommended to prevent reinfestation such as:
 1. Long-term monitoring
 2. Continued outreach and education
 3. Partnerships with business and interest groups
 4. Strengthening relevant regulations
 5. Identify staffing needs
 6. Identify research needs
- b. Ensure the potential for introduction from nearby commercial operations (shipping, bait shops, aquaculture, aquarium shops) is removed or minimized to the extent possible.

Step 14. Prepare Demobilization Plan

- a. During the response, the Planning Section is responsible for preparation of a Demobilization Plan and having it approved by the Incident Commander(s). The purpose of the Demobilization Plan is to assure that all participants understand their role in an orderly, safe and efficient demobilization of incident resources as rapid response procedures are completed. Equipment and supplies must be returned to appropriate locations, time and cost accounting reports must be completed within required timeframes, and any other required progress and final reports must be prepared and submitted.

Step 15. Monitor the outcome of the Rapid Response

- a. Evaluate Eradication or Control Efficacy: If eradication or control actions were taken during the response, monitor and evaluate the efficacy of the treatment(s) used and conduct environmental monitoring that may be necessary to meet regulatory compliance requirements. Prepare a monitoring report and submit a copy to the ISC. If the control or eradication measures require months or years to implement, these evaluation reports may take the form of periodic progress reports.
 1. If the treatments were not successful or an acceptable level of progress is not being achieved, evaluate the potential for remedial measures to improve the results. If there is a strong possibility for improvement, propose possible remedial actions as part of the monitoring report.
- b. If eradication or control measures were not taken, there may be a decision to conduct monitoring of the AIS population and provide monitoring reports to the DFG Invasive Species Program.

Step 16. Undertake remedial actions and long-term follow up

- a. Remedial Action Approval: If there is efficacy monitoring prior to the demobilization of the incident and remedial actions are recommended, the Incident Commander(s) can approve the implementation of a remedial action plan and utilize the assembled rapid response personnel, assuming any environmental regulatory and/or fiscal issues are addressed.
- b. Remedial Action Monitoring: Remedial actions and their results will require subsequent monitoring.
- c. Follow-Up Actions: If longer-term actions are necessary, the Planning Section, with input from other rapid response personnel and outside expert input as necessary, will develop a follow-up plan that will be submitted to the DFG Invasive Species Program.

Step 17. Implement the Demobilization Plan

- a. Implement the demobilization plan described in Step 14. The work will be carried out by the Incident Teams and Specialists with oversight and coordination from the Incident Command Staff. Reports will be submitted to the ISC for approval and appropriate distribution.

IV. PLANNING FOR RAPID RESPONSE

This section suggests 11 basic task areas necessary to plan for rapid response and completion of this plan.

Task 1. Collaborate to complete plan

Representatives from public agencies and other organizations that are currently involved in rapid response work, or likely to be involved in the foreseeable future, should collaborate to finalize the Rapid Response Plan (see Task 4). The goal is to have a plan that can be the basis for interagency agreements (Task 2). Note that not every item in Task 4 needs to be complete in order to have a plan that supports such agreements. This group could also prioritize and carry out parts of additional planning tasks listed below. The collaboration necessary to carry out the tasks in this section could occur through a technical advisory panel to the CAAIST or AISWG (collaborative groups described in the CAISMP), through the California Biodiversity Council (CBC) Rapid Response Working Group, or through executive or upper management staff of cooperating agencies assigning staff to an interagency Rapid Response Planning Team.

Task 2. Enter into cooperative agreements

DFG Invasive Species Program staff will work with cooperating agencies and organizations to produce a list of entities that should be invited to sign Memoranda of Understanding, Implementation Agreements or similar instruments to cooperate on rapid response to AIS. Existing information in the CAISMP and information collected by CBC Rapid Response Working Group will be used, among other sources, to generate this list. The proposed list and a conceptual outline for these agreements will be presented to CBC and/or directly to relevant agency executives.

Task 3. Secure funding

This Plan cannot be implemented without adequate, stable and dedicated funding. Agencies signatory to the Rapid Response agreement(s) should coordinate efforts to pursue funding options for Rapid Response program development, training and implementation.

Organizations and industries that have a vested interest in successful early detection and rapid response systems could participate in the development of funding sources.

- a. Funding Analysis: Consider the following types of funding sources:
 1. A permanent funding source(s) maintained solely for rapid response actions. Without this, rapid response may not occur or may only occur by redirecting funds on short notice from other important programs.
 2. A user-fee system based on vectors for AIS introductions. This would be similar in concept to fees paid by the shipping industry for ballast water inspections or fees paid by the petroleum industry for an oil spill response program. Methods used by states that already have dedicated funding for rapid response can be emulated.
 3. Private/public partnerships for supporting rapid response efforts in the form of equipment, supplies, personnel or funding.
 4. One-time grants for specific planning or research projects related to rapid response.
- b. Taxonomy Funds: Develop funding for taxonomic work to identify potential AIS specimens. In some cases, this will include genetic analysis (e.g. to determine presence or absence of microscopic larvae of AIS species, or help determine the origin of an introduction). Expert taxonomic work will bolster confidence that subsequent management decisions are based on solid information. There should also be funding to maintain specimens. The proper maintenance and documentation of specimens is especially important in cases where infestations are the subject of law enforcement actions and may also be beneficial for future AIS identification needs and research.
- c. Professional Cost Analysis: Consider whether a detailed, professional analysis of rapid response costs to support funding requests is necessary (Task 10b).
- d. Funding Development: Consider using funding for development purposes (i.e. grant writing).

Task 4. Finalize the Rapid Response Plan

Work that needs to be done to finalize the Rapid Response Plan includes:

- a. Implementation Criteria: Develop the process and criteria for the State to use in determining the course of action to take for any new AIS introductions. Circulate for peer review.
- b. Likely Species & Scenarios: Identify likely species and/or early detection scenarios for AIS. Run these scenarios through the criteria developed for Task 4a to fine-tune the criteria.
- c. Agency Preparation: Develop information needed to help cooperating agencies designate and train, in advance, potential responders to AIS introductions.
- d. Alternate Staff: Develop a procedure to designate and prepare potential alternate staff. This could avoid gaps in getting work done and minimize managerial time spent searching for substitutes during a response.
- e. Personnel Directory: Develop a statewide Rapid Response Personnel Directory. These people could be called upon to participate during rapid response activities, and into an ICS response. Ideally the Directory should include staff that represent the full spectrum of knowledge and skills that might be necessary during rapid response activities (e.g. ICS

implementation, logistics, finance, legal and various technical experts). The development of this list and staff participation in Rapid Response planning and training will likely require support of executive level staff from the cooperating agencies.

- f. Resource Directory: Develop and maintain a directory among cooperating agencies for equipment, operations centers, supply sources and associated contact people so that resources can be mobilized as quickly as possible during a response.
- g. Taxonomic Experts: A list of taxonomic experts and protocols for requesting and using their services needs to be developed and periodically reviewed and updated. This would be a list of experts who have agreed to identify specimens for AIS Rapid Response efforts and appropriately preserve and catalog them.
- h. Local Assistance Protocol: Develop a protocol for responding to a private entity or local government agency that wants to conduct a rapid response under its own direction but requests assistance or permits from one or more agencies signatory to the statewide Rapid Response Plan. Include this protocol in the rapid response training program.
- i. Notification List: Develop a list of whom, outside of those directly involved, needs to be notified when rapid response procedures are being planned and implemented.
- j. Database Compatibility: Consider whether information should be collected in a particular manner in order to be compatible with existing AIS databases. For example, the North American Weed Management Association has a list of required elements for weed mapping projects (www.nawma.org).

Task 5. Streamline permit processes for rapid response

DFG Invasive Species Program staff will coordinate with staff from relevant agencies to investigate and pursue possibilities for streamlining the regulatory permit processes that might be required for rapid response measures. General measures or best management practices necessary to comply with streamlined permitting can be incorporated into the Rapid Response Plan.

Task 6. Revise the Rapid Response Plan

- a. Incorporate New Information: Periodically revise the Plan and incorporate anything learned by evaluating the Plan's effectiveness and consulting current scientific research and related technological developments. Revisions may also be necessary due to changes in funding, agency restructuring and environmental regulations. The interagency agreement(s) to cooperate on rapid response should include a procedure for making revisions to the Plan.
- b. Notification of Plan Changes: DFG Invasive Species Coordinator should ensure that adopted changes to the Plan are circulated to people listed in the Rapid Response Personnel Directory and other appropriate staff among the cooperating agencies and organizations. Changes should be addressed in training activities.
- c. Update Directories: DFG Invasive Species Program staff, with assistance and input from cooperating agencies and organizations, will be responsible for the periodic update and circulation of the Rapid Response Personnel Directory, the Rapid Response Resource Directory and the list of taxonomic experts.

Task 7. Develop species- or location-specific rapid response plans

Identify and prioritize certain species, groups of species or certain locations for the development of specific rapid response plans. Detailed technical information can allow this type of response plan to be implemented more efficiently than a generic response plan. The development of species- or location-specific rapid response plans is called for in Action 4A3 of the CAISMP. The process of prioritizing which species warrant the development of rapid response plans will also help guide the development of outreach materials for early detection efforts.

Task 8. Train employees, participants and team members

- a. Training Program: Agencies that agree to cooperate on AIS rapid response need to participate in the development of a training program and train the employees likely to be involved in rapid response activities. Potential rapid response participants need to be familiar with the Rapid Response Plan, Incident Command System (ICS), and may need specialized training related to their likely duties during a rapid response. ICS training is available on-line at: <http://training.fema.gov/IS/>.

There may be a need to develop supplemental training materials and presentations for information specific to California, AIS or other topics.

- b. Drills: Ensure that training includes AIS rapid response drills using a variety of scenarios and locations around the state. This will also assist in fine-tuning the Rapid Response Plan.

Task 9. Conduct education and outreach

- a. Outreach Planning: Outreach specialists from participating agencies and organizations should develop a plan of potential methods and protocols for conducting outreach to local communities, interest groups and the media during rapid response procedures. This could include sharing contact information for key groups such as boaters, anglers and marina owners.
- b. Disruption of Regular Work: Within the cooperating agencies, supervisors of employees who are in the Rapid Response Personnel Directory should be made aware that rapid response work can supersede other projects on very short notice. Supervisors and employees who are on rapid response teams could discuss in advance how they plan to handle this potential source of disruption.

Task 10. Conduct research necessary for improved rapid response

- a. Response Research: Academic institutions, government agencies and other organizations that agree to cooperate on rapid response should work together through various AIS working groups, professional and environmental organizations and commercial interests to promote research that can specifically improve or promote rapid response efforts.
- b. Cost Research: Research the costs of rapid response, possible funding mechanisms (Task 3) and, if feasible, study the environmental and economic benefits and costs of conducting rapid response efforts versus not conducting rapid response. This may help governments decide how much to invest in rapid response measures.

Task 11. Develop interim rapid response protocols

This section addresses the question: What steps can be taken to prepare to implement a rapid response effort while a formal plan is going through the review and approval processes?

- a. Memorandum of Understanding (MOU): The Directors of the appropriate agencies could sign an interim MOU directing their staff to participate in rapid response planning and implementation if a new AIS introduction occurs prior to the approval of the final plan.
- b. Interim Funding: Management staff could identify and pursue interim funding sources for implementing a rapid response program.
- c. Interim Strategy: Management level staff from cooperating agencies could informally agree upon an interim strategy regarding roles and responsibilities should an AIS introduction occur.
- d. Permitting: Management level staff from cooperating agencies could discuss how, in the absence of a formal streamlined permitting process, their staff could work within the existing regulatory permit programs to facilitate a rapid response operation and direct staff to follow through on these interim measures.
- e. Employee Assignment: Management level staff of cooperating agencies could assign employees to an interim core rapid response team or working group. This team could participate in some advance preparation and planning. In the event of a rapid response, this team would need to be augmented by additional staff based on the location of the response and the necessary areas of expertise.

V: Supporting Materials

Rapid Response Form 1. Suspect AIS Sighting Report

The reporter may not be able to provide all of the information requested below, but please fill in as many of the information fields as possible.

Report Tracking Number: _____ Date of Sighting: _____

Reporter's First and Last Name: _____

Reporter's Phone Numbers: Home: _____ Work: _____

Cell: _____

Reporter's E-Mail Address: _____

Reporter's Mailing Address:

Type of Organism (as specific a descriptive label as possible (e.g. submerged plant, shellfish, etc.):

Description of size, color, shape and other distinguishing characteristics:

Approximate number of individuals or area they occupy:

Location of sighting:

Directions and description of nearby landmarks:

Were any photographs taken or specimens collected? If so, where can they be obtained?

Landowner or Land Manager:

Possible Source of Introduction:

Name and Contact Information of Person Filling Out This Form:

Rapid Response Form 2. AIS Alert Report 1

To be filled out by Species Identification Team member following up on a preliminary report of a possible AIS sighting (Form 1). The AIS Report will be expanded to two pages in the final draft to reduce the crowding on this form.

Species Name: _____ Report Tracking # _____
Name of Person Filling out Form: _____ Phone Number(s): _____
Agency: _____
Address: _____ E-mail address: _____

Reporter's Name: _____
Reporter's Phone Number(s): _____
Reporter's e-mail: _____

Date of Pest Sighting: _____
If the identification was verified by expert, who provided the verification?
Verifier's phone number(s): _____ E-mail: _____

Location of voucher specimens: _____

Sighting Location (if possible attach a map showing the location):
County: _____ Body of water: _____

Landowner/Manager: _____
Describe location
(Relationship to nearby road intersection, pier, mile marker, buoy, other landmarks)

If possible, please provide map information (You choose the system):

T____ R____ Sec____, _____1/4 of _____1/4, Meridian: H__ M__ S__
T____ R____ Sec____, _____1/4 of _____1/4, Meridian: H__ M__ S__

Quad Name: _____ Source of Coordinates (GPS, topo map & type): _____
GPS Make and Model: _____ Horizontal Accuracy _____ meters/feet

Datum: NAD27____ NAD83____ WGS84____
Coord. System Zone 10 ____ Zone 11____ or Geographic Latitude/Longitude _____

Describe pest species population (approximate number of individuals or stems, area they occupy)

Describe any evidence of reproduction (flowering, juvenile animals, egg masses, etc.)

Describe habitat: (e.g. plant community, associated plant species, host species, water depth, distance from bank, substrate characteristics (e.g. gravel, large rocks, silt, sand), etc.)

Photographs can be accessed at:

1 Based on California Department of Fish & Game, California Natural Diversity Data Base, "Native Species Field Survey Form" and the "Maui County Report A Pest Online Report Form," Maui County, HI.

VI. REFERENCES

- Akers, P. California Department of Food and Agriculture (DFA): *Draft Rapid Response Plan*. Prepared for the Western Regional Panel on Aquatic Nuisance Species, 27 pp.
- Anderson, LWJ. 2005. "California's reaction to *Caulerpa taxifolia*: a model for invasive species rapid response." *Biological Invasions* 7: 1003-1016.
- California Department of Fish and Game, Office of Spill Prevention and Response. 2001 *California Oil Spill Contingency Plan*, Sacramento, CA, 34 pp. (plus appendices).
- California Department of Fish and Game (DFG), Biogeographic Information Branch. 2003. "California Native Species Field Survey Form."
- California Department of Food and Agriculture, Integrated Pest Control Branch, Plant Health and Pest Prevention Services. *Model Rapid Response Plan for Aquatic Nuisance Species*. Prepared for the Western Regional Panel on Aquatic Nuisance Species, 57 pp.
- Federal Interagency Committee for the Management of Noxious and Exotic Weeds. 2001. *National Early Warning and Rapid Response System for Invasive Plants in the United States, Draft Action Plan*. Washington, D.C. August 28, 2001, 22 pp.
- Federal Emergency Management Agency. 2006. *National Incident Management System Homepage*. www.fema.gov/emergency/nims.
- Fraidenburg, M. 2005. *Rapid Response Plan for Zebra Mussels in the Columbia Basin*. Prepared for the Pacific States Marine Fisheries Commission, Olympia, WA. November 18, 2005, 35 pp.
- Gulf of Mexico Regional Panel on Aquatic Invasive Species. 2004. *Rapid Response Plan for the Gulf of Mexico Region*. Prepared for the National Aquatic Nuisance Species Task Force, December 2004.
- Great Lakes Commission Staff, Resource Management Program. 2004. *Model Rapid Response Plan for Great Lakes Aquatic Invasions, Iteration II*. Prepared for the U.S. Environmental Protection Agency, Great Lakes National Program Office. April 2004, 56 pp.
- Heimowitz, P and S Phillips. 2006. *Rapid Response Plan for Zebra Mussels in the Columbia River Basin: A Comprehensive Multi-Agency Strategy to Expediently Guide Rapid Response Activities* (Working Draft). U.S. Fish and Wildlife Service and Pacific States Marine Fisheries Commission. September 2006.
- Maui County, HI. 2006 *Maui County Report a Pest Homepage*. <http://pbin.nbii.gov/reportapest/maui/>. Also contact: reportapest-maui@hawaii.edu.
- National Invasive Species Council. 2003. *General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems*. Version 1. 16 pp.
- National Wildfire Coordinating Group. 1994. *Incident Command System National Training Curriculum: Organizational Overview, Module 3*, I-200. National Interagency Fire Center, Publication NFES #2443. October 1994. 36pp.
- U.S. Coast Guard. 2001. *Incident Management Handbook, Incident Command System (ICS)*. Commandant Publication P3120.17, Washington, D.C. <http://www.lartu.org/ics/USCG%20FOG.pdf>

Veldhuizen, T. 2004. *Zebra Mussel Detection and Outreach Program*, California Department of Water Resources.

Veldhuizen, T. 2004. *Zebra Mussel Rapid Response Plan for California*. Prepared for the California Bay-Delta Authority (CBDA Project No. 99-F07) and the U.S. Fish and Wildlife Service. Sacramento, CA. June 30, 2004.

APPENDICES B-D

Introductory Notes

These appendices provide a detailed description of the primary federal and state laws, regulations and public policies that empower and direct different government agencies to manage AIS in California. They also describe the primary activities of government agencies – state, federal and regional – involved in AIS management, as well as most of the major committees and boards set up to coordinate and oversee such activities. These details are provided to support and expand on the information contained in the Management Framework provided in Chapter 4 and the Summary of Laws provided in Chapter 5 of this plan (as such, there is some repetition of information). While these appendices attempt to be comprehensive, there is inadequate space to present every single AIS program, law or activity in the state and nation. Through the web links provided below and further information in the appendices, more details on legal authorities and AIS stakeholders is available to all interested parties. A key to the acronyms used in these appendices can be found in the Acronym Glossary in the introductory pages of this plan. (*Note: Some laws and policies refer to ANS, aquatic nuisance species, rather than AIS, aquatic invasive species.*)

APPENDIX B: FEDERAL AUTHORITIES, LEGISLATION & AGENCIES

FEDERAL AUTHORITIES

No single federal agency has comprehensive authority for all aspects of aquatic invasive species management. Federal agencies with regulatory authority over the introduction and transport of aquatic species that may be invasive or noxious include the U.S. Department of Agriculture Animal Plant Health Inspection Service, the U.S. Department of Agriculture Agricultural Marketing Service, the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Commerce (DOC), and the U.S. Coast Guard (USCG). Many other agencies have programs and responsibilities that address components of AIS, such as importation, interstate transport, exclusion, control and eradication.

The primary federal authorities for managing and regulating AIS derive from the National Environmental Policy Act, the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA, 1990), the National Invasive Species Act (NISA, 1996), the Lacey Act, the Plant Pest Act, the Federal Noxious Weed Act, and the Endangered Species Act. An Executive Order signed by President William J. Clinton on February 3, 1999 expanded federal efforts to address AIS. The order created a National Invasive Species Council charged with developing a comprehensive plan to minimize the economic, ecological and human health impacts of invasive species.

Brief descriptions of the President's Executive Order, NANPCA and NISA are provided below, followed by an explanation of how federal activities are now coordinated through the national Aquatic Nuisance Species Task Force (ANSTF) and the National Invasive Species Council (NISC), and by descriptions of some of the earlier acts and laws still enforced in AIS management.

Primary Federal AIS Authorities

1990 – Nonindigenous Aquatic Nuisance Prevention and Control Act

(NANPCA; Title I of P. No.101-646, 16 U.S.C. 4701 et seq.)

<http://www.anstaskforce.gov/default.php>

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) established a federal program to prevent the introduction and control the spread of introduced aquatic nuisance species. The act provides an institutional framework that promotes and coordinates research, develops and applies prevention and control strategies, establishes national priorities, educates and informs citizens, and coordinates public programs. The act calls upon states to develop and implement comprehensive state management plans to prevent introduction and control the spread of aquatic nuisance species (ANS). Section 1002 of NANPCA outlines five objectives of the law, as follows:

1. Prevent further unintentional introductions of nonindigenous aquatic species;
2. Coordinate federally funded research, control efforts, and information dissemination;
3. Develop and carry out environmentally sound control methods to prevent, monitor and control unintentional introductions;
4. Understand and minimize economic and ecological damage; and
5. Establish a program of research and technology development to assist state governments.

Section 1201 of the act established the national ANSTF, co-chaired by the USFWS and the National Oceanic and Atmospheric Administration. The Task Force is charged with coordinating governmental efforts related to ANS prevention and control. The ANSTF consists of 10 federal agency representatives and 12 ex officio members representing nonfederal governmental agencies (see Other AIS Interests, Appendix D).

**1996 – National Invasive Species Act
(NISA; P. No.104-332)**

In 1996, the National Invasive Species Act (NISA) amended the NANPCA of 1990 to mandate ballast water exchange for vessels entering the Great Lakes and to implement voluntary ballast water exchange guidelines for all vessels with ballast on board that enter U.S. waters from outside the U.S. Exclusive Economic Zone (U.S. EEZ). Though the act did not make exchange mandatory, it did require all vessels to submit a report form to the USCG documenting specific ballast water management practices. It also authorized the USCG to toughen requirements if compliance proved unsatisfactory, which it did in 2004 (see below). NISA authorized funding for research on aquatic nuisance species prevention and control in Chesapeake Bay, the Gulf of Mexico, the Pacific coast, the Atlantic coast, and the San Francisco Bay-Delta Estuary. In addition, NISA required a ballast water management program to demonstrate technologies and practices to prevent ANS from being introduced into and spread through ballast water in U.S. waters. It modified both the composition and research priorities of the ANSTF and requirements for the zebra mussel demonstration program.

**1999 – Executive Order 13112
(64 Fed. Reg. 6183)**

<http://www.invasivespeciesinfo.gov/council/main.shtml>

President William J. Clinton signed Executive Order 13112 on Invasive Species on February 3, 1999. The order seeks to prevent the introduction of invasive species, provide for their control and minimize their impacts through improved coordination of federal agency efforts under a National Invasive Species Management Plan developed by the newly created National Invasive Species Council (NISC). The order directs all federal agencies to address invasive species concerns, as well as to refrain from actions likely to increase invasive species problems.

The NISC has three co-chairs: the secretaries of Agriculture, Commerce, and the Interior. Members also include the secretaries of State, Defense, Homeland Security, Treasury, Transportation and Health and Human Services, as well as the administrators of USEPA, the U.S. Agency for International Development, the U.S Trade Representative and the National Aeronautics and Space Administration. The NISC released the first National Invasive Species Management Plan in 2001. The NISC is currently working to establish federal and non-federal task teams to implement the plan's action items.

The NISC actively works with the Invasive Species Advisory Committee (ISAC), also established under the order. The ISAC is composed of stakeholder representatives from state governments, industry, conservation groups, academia and other interests. Its role is to advise the federal government on the issue of invasive species.

To help coordinate the work of the NISC and the ANSTF, the Department of Commerce (DOC) Policy Liaison to the NISC also serves as the DOC representative to the ANSTF. In addition, NISC and the ANSTF have formed joint working groups on each of the following topics: pathways, risk analysis and screening.

The ANSTF and the NISC are similar in that they perform coordinating functions but differ in their responsibilities: the NISC addresses all invasive species, while the ANSTF focuses on aquatic invasive species. Although many of the same principles apply to managing aquatic and terrestrial invasive species, many management issues are unique to the aquatic environment and need to be addressed separately.

1993-2005 – Coast Guard Regulations under NISA (33 CFR 151)

The USCG has promulgated a number of ballast water management regulations based on the authority given to it by NANPCA in 1990 and NISA in 1996. As directed by NANPCA, in 1993, the USCG implemented regulations requiring vessels entering the Great Lakes and the Hudson River to conduct ballast water management after operating outside the U.S. EEZ.

To comply with the NISA, the USCG established regulations and guidelines to control the introduction of ANS via ballast water discharges in U.S. waters other than the Great Lakes. Compliance with the resulting voluntary ballast management and mandatory reporting program was only 30%, according to a 2002 Report to Congress. Therefore, under the authority of NISA, the USCG established mandatory ballast water management requirements and penalties for non-compliance. The mandatory program requires ships to use one of three ballast water management methods: 1) retaining ballast water on board, 2) conducting a mid-ocean exchange, and/or 3) using an approved ballast water treatment method. All vessels are required to submit ballast water management reports (failure to submit a report can now result in penalties). These mandatory regulations came into effect on September 27, 2004. Federal regulations also require vessels to maintain a ballast water management plan that is specific for that vessel and assigns responsibility to the master or appropriate official to understand and execute the ballast water management strategy for that vessel.

Under NANPCA/NISA, states are specifically permitted to regulate ballast water on ships. Several states have elected to do so to various degrees. In addition to reporting requirements, California, Oregon and Washington have ballast water exchange requirements and California will soon specify a ballast water discharge standard (see California Authorities section).

Other Federal Authorities

Animal Damage Control Act (1931)

<http://www.aphis.usda.gov/>

Under the Animal Damage Control Act, the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service has authority to control wildlife damage on federal, state, or private land, including damage from invasive species. The act protects field crops, vegetables, fruits, nuts, horticultural crops and commercial forests; freshwater aquaculture ponds and marine species cultivation areas; livestock on public and private range and in feedlots; public and private buildings and facilities; civilian and military aircraft; and public health.

Animal Health Protection Act (2002)

(7 U.S.C Sec. 8301, et seq.)

<http://www.aphis.usda.gov/>

The Animal Health Protection Act provides a flexible statutory framework for protecting domestic livestock from foreign pests and diseases. This act authorizes the USDA to promulgate regulations and take measures to prevent the introduction and dissemination of pests and diseases of livestock. The scope of such regulatory authority extends to the movement of all animals, domestic and wild, except humans. The fact that a pest or disease primarily affects animals other than livestock, including humans, does not limit USDA's authority to regulate a species, so long as it carries a pest or disease of livestock. Further, the act defines "livestock" to mean all farm-raised animals, clarifying the USDA's authority to conduct animal health protection activities in connection with farm-raised aquatic animals.

Clean Water Act

<http://www.epa.gov/r5water/cwa.htm>

<http://unds.bah.com/default.htm>

Various sections of the Clean Water Act (CWA) regulate discharges of pollutants (such as AIS and ballast water) and fill material to waters of the United States. Section 402 of the act authorizes the National Pollutant Discharge Elimination System (NPDES), a permit program intended to reduce and eliminate the discharge of pollutants from point sources that threaten to impair beneficial uses of water bodies. The act defines point sources to include vessels (Section 502(14)) and prohibits all point source discharges of pollutants into U.S. waters unless a permit has been issued either under Section 402 (NPDES) or Section 404 (dredge and fill activities).

California's Waste Discharge Requirements, issued by the state's Regional Water Quality Control Boards (RWQCBs), incorporate the authority of the federal NPDES permitting program for discharges of wastes to surface waters. In addition, under Section 303(d) of the each of the RWQCBs has the requirement to establish "a total maximum daily load for those pollutants which the (Environmental Protection Agency (USEPA)) Administrator identifies under Section 304(a) (2) as suitable for such calculation." This section of the CWA was developed to support a water quality-based system of effluent limits for chemical pollutants; the interpretation of what an allowable load of invasive species is has not been defined.

Under Section 305(b) of the CWA, California's nine RWQCBs are required to assess water bodies for attainment of beneficial uses every two years and report to the USEPA. In cases where beneficial uses of water bodies are shown to be impaired, Section 303(d) requires the Regional Boards to list the impaired water bodies and "establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters." Section 502(6) defines "pollutant" as dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, *biological materials*, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal and agricultural waste discharged into water. Ballast water is considered to be a pollutant in discharges based on the above definition and definitions in the State Water Code.

Endangered Species Act of 1973

(ESA; 16 U.S.C.A. §§ 1531 to 1544)

<http://www.fws.gov/angered/>

The ESA aims to protect endangered and threatened species. When non-native invasive species threaten endangered species, this act could be used as basis for their eradication or control by the USFWS or by the National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NOAA-Fisheries Service) The potential to harm a federally-listed species and the need to obtain a permit from the USFWS or NOAA-Fisheries Service should be taken into consideration when selecting methods to manage AIS.

Lacey Act (1900; amended 1998)

<http://www.fws.gov/laws/lawsdigest/lacey.html>

As the first federal act that tried to control migrations and importations of nonindigenous species, the Lacey Act prohibits the importation of a list of designated species and other vertebrates, mollusks and crustaceans that are "injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States." Under this law, it is unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

The Lacey Act allows for the import of species for scientific, medical, education, exhibition or propagation purposes. The USFWS is the lead agency for enforcing the Lacey Act's prohibition of fish and wildlife imports.

National Environmental Policy Act of 1970
(NEPA; 42 U.S.C.A. §§ 4321 to 4370e)
<http://www.epa.gov/compliance/nepa/index.html>

NEPA requires the consideration of environmental impacts for any federal action, including direct federal activities, permitting and federal funding of activities by another entity. NEPA environmental documents may include a “finding of no significant impact (FONSI),” an “environmental assessment (EA),” or a full “environmental impact statement (EIS).” Potential impacts of invasive species, both direct and indirect, may be among the issues that should be considered under NEPA.

Noxious Weed Act
(1974; 7 U.S.C. § 360)

Section 15 of the Federal Noxious Weed Act requires federal land management agencies to develop and establish a management program for control of undesirable plants that are classified under state or federal law as undesirable, noxious, harmful, injurious or poisonous, on federal lands under the agency’s jurisdiction (7 U.S.C. 2814(a)). The act also requires the federal land management agencies to enter into cooperative agreements to coordinate the management of undesirable plant species on federal lands where similar programs are being implemented on state and private lands in the same area (7 U.S.C. 2814(c)). The Secretaries of Agriculture and the Interior must coordinate their respective control, research and educational efforts relating to noxious weeds (7 U.S.C. 2814(f)). USDA’s Departmental Regulation 9500-10 sets forth departmental policy relating to the management and coordination of noxious weeds activities among the agencies within USDA and other entities.

Plant Protection Act
(2000; 7 U.S.C. 7701)
<http://www.aphis.usda.gov/>

The Plant Protection Act (PPA) authorizes the USDA to prohibit or restrict the importation or interstate movement of any plant, plant product, biological control organism, noxious weed, article or means of conveyance if the Secretary of Agriculture determines that the prohibition or restriction is necessary to prevent the introduction into the United States, or the dissemination within the United States, of a plant pest or noxious weed.

The PPA specifically authorizes USDA to develop integrated management plans for noxious weeds for the geographic region or ecological range where the noxious weed is found in the United States. In addition, the act authorizes the USDA to cooperate with other federal agencies or entities, states or political subdivisions of states, national governments, local governments of other nations, domestic or international organizations or associations, and other persons to carry out the provisions of the act.

FEDERAL AGENCIES

Numerous federal agencies, presented here in alphabetical order, have authority to implement the laws and policies described above. Other federal agencies have mandates impacted by AIS and thus engage in research, monitoring, prevention or control programs. Still others delegate primary responsibility for implementation to state and regional agencies (see next section). The following descriptions attempt to provide a general introduction to the scope of each agency’s work, as well as a brief review of the agency’s recent (as of 2006) major AIS-related activities.

Bureau of Reclamation

<http://www.usbr.gov/>

The Bureau of Reclamation is involved in several important projects related to this issue. The Bureau has partnered with the DFG, USFWS and others to investigate the Chinese mitten crab infestation in the Sacramento-San Joaquin Delta. The agency participates in the Giant *Salvinia* Task Force's efforts to limit the spread of this invader in the Colorado River (see Appendix D), has a detection program for water hyacinth and participates in activities related to the New Zealand mudsnail infestation in Putah Creek. The agency also participated in DFA's *Hydrilla* Eradication Program.

National Oceanic and Atmospheric Administration (NOAA)

<http://www.noaa.gov/>

NOAA is the primary federal agency charged with management of marine resources. NOAA is the co-chair of the ANSTF and has been designated the Department of Commerce lead as co-chair of the National Invasive Species Council. Within NOAA, a number of national, state and regional agencies and programs are actively involved in AIS issues in California. These include: National Estuarine Research Reserve System (NERRS), a network of protected areas established for long-term research, education and stewardship; National Marine Fisheries Service, which works to protect fisheries habitat, commercial fisheries and endangered fish; National Marine Sanctuaries, the nation's system of marine protected areas, and Sea Grant, a nationwide network of 30 university-based programs that work with coastal communities and conduct scientific research and education projects designed to foster science-based decisions for the use and conservation of U.S. aquatic resources.

National Estuarine Research Reserve System (NOAA – NERRS)

<http://nerrs.noaa.gov/>

<http://sfbaynerr.org>

<http://www.elkhornslough.org/>

<http://nerrs.noaa.gov/TijuanaRiver/>

There are three reserves in California that provide a platform to increase communication between scientists, decision-makers, land managers, and the public in order to better deal with AIS issues. The San Francisco Bay reserve protects two large, relatively pristine, tidal wetlands: China Camp State Park in Marin County and Rush Ranch Open Space in Solano County. These sites are part of an AIS early detection and assessment study and detailed vegetation maps are being created to serve as a baseline to evaluate future invasions. China Camp serves as an uninvaded reference site for marshes invaded by *Spartina* hybrids in San Francisco Bay. Rush Ranch is a site of active research on invasive fish and invertebrates. The Elkhorn Slough reserve protects approximately 1,400 acres, including Elkhorn Slough, one of the few coastal wetlands remaining in California. Elkhorn estuarine habitats have over 60 species of non-native invertebrates, over 20 species of non-native plants and a few non-native fish and algae. All of these are currently widespread, so eradication seems impossible. Efforts are focused on early detection and eradication of species identified as "least wanted" invaders such as Chinese mitten crabs and *Caulerpa*. The reserve launched an early detection program for aquatic non-native invaders in 2002. The Tijuana River reserve's 2,500 acres encompass beach, dune, mudflat, salt marsh, riparian, coastal sage and upland habitats surrounded by the growing cities of Tijuana, Imperial Beach and San Diego. Critical invasive species issues include: tamarisk, ice plant and other exotic plants displacing native species in the salt marsh and upland habitats; ongoing surveys to understand the dynamics of AIS; and efforts to understand ecosystem recovery following eradication of invasives.

National Marine Fisheries Service (NOAA – Fisheries Service)

<http://www.nmfs.noaa.gov/>

NOAA-Fisheries Service is in charge sustaining the nation's fisheries, many of which are being directly impacted by AIS, and is involved in many AIS projects in California. It has a key role on the Southern California Caulerpa Action Team. NOAA-Fisheries Service is also involved with a variety of other collaborative research projects including: ballast water exchange, AIS risk evaluation research and hull fouling research funded by the Port of Oakland; analysis of biofouling communities and community effects; and surveys and experimental treatments of several invasive species in San Francisco Bay. NOAA-Fisheries Service also participates on several AIS advisory and coordinating committees including: the Pacific Ballast Water Group, Non-Native Invasive Species Advisory Council and the West Coast Ballast Outreach Project Advisory Team.

National Marine Sanctuaries (NOAA – NMS)

<http://sanctuaries.noaa.gov/>

<http://channelislands.noaa.gov/>

<http://cordellbank.noaa.gov/>

<http://farallones.noaa.gov/>

<http://montereybay.noaa.gov/>

California has four sanctuaries – Channel Islands NMS, Cordell Banks NMS, Gulf of Farallones NMS and Monterey Bay NMS. The latter two sanctuaries are in the process of developing aquatic invasive species management plans and have conducted monitoring programs for AIS.

National Sea Grant (NOAA – Sea Grant)

<http://www.seagrants.noaa.gov/>

<http://www.csgc.ucsd.edu>

<http://ballast-outreach-ucsgep.ucdavis.edu/>

The National Sea Grant Program is a partnership between the nation's universities and NOAA (under the Office of Oceanic and Atmospheric Research) that began in 1966. The California Sea Grant program is the largest of these programs. Sea Grant began the West Coast Ballast Outreach Project in 1999 (co-sponsored by the CALFED Bay-Delta Program) to address concerns that ballast water discharges could be introducing foreign marine species into the state's coastal and estuarine ecosystems. The project educates the maritime industry about the ecological seriousness of aquatic exotic species by publishing the newsletter "Ballast Exchange," maintaining an educational Web site and coordinating workshops. In addition, California Sea Grant provides two major services to the state. First, the research arm of California Sea Grant, operating out of the Scripps Institute for Oceanography in La Jolla, funds critical coastal and marine research through an annual request for proposal and a National Strategic Initiative (NSI) program. Through both of these avenues, the college program funded approximately \$2.6 million in research on invasive species between 1995 and 2003. Second, Sea Grant and the University of California Cooperative Extension jointly fund a network of eleven advisors and specialists who work on applied research and outreach projects throughout the state, including those related to AIS. Sea Grant funding has supported a wide variety of research projects on key invasive species, such as the Chinese mitten crab, European green crab, an exotic Australian isopod, several invasive seaweeds, and *Spartina* hybrids. Sea Grant sponsored research led to the eradication of the South African *sabellid* worm at the site near Cayucos, California, where it had become established.

National Park Service (NPS)

www.nps.gov

NPS strives to preserve the unimpaired natural and cultural resources of the national park system for the enjoyment, education and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country. The NPS has several invasive species monitoring, control, research and eradication programs in California. Eradication and control are supported by two programs. The first is the (California) Exotic Plant Management Team (EPMT), which travels around the state to national parks that have requested assistance in removal and control projects. The EPMT has traditionally focused on terrestrial non-natives but could work on aquatic invaders. Through the second program, individual parks can request funds from Washington or the NPS Western Region for control and eradication projects. Natural resource inventories and monitoring activities occur in all of the National Parks in California, and these programs are well positioned to alert state managers to emerging and growing threats from invasive species. Information from these programs could be shared among the California AIS plan partners and benefit the state's early detection efforts. Finally, the NPS actively supports and hosts research projects on impacts of invasive species on ecological communities. National Parks in California, that participate with the EPMT, conduct invasive species inventories, monitoring and research on lands totaling about 2.4 million acres and include hundreds of miles of coastline. Significant education and outreach occurs at all of these sites.

U.S. Army Corps of Engineers (COE)

<http://www.usace.army.mil/>

The COE provides engineering, construction and environmental project services for the military and local governments. Congress authorizes the COE to assist local governments with water resource development needs, which include flood control, navigation, ecosystem restoration and watershed planning. For ecosystem restoration, this includes research on invasive species. Specific programs addressing invasive species issues include the Aquatic Nuisance Species Research Program, the Aquatic Plant Control Research Program and the Water Operations Technical Support Program. COE is also responsible for permitting aquaculture projects, including oyster farms, which often involves AIS considerations.

U.S. Coast Guard (USCG)

<http://www.uscg.mil/hq/g-m/mso/bwm.htm>

The USCG has established a mandatory program aimed at keeping aquatic nuisance species out of U.S. waters using ballast water management methods. USCG activities focus on enforcement and monitoring to ensure compliance with the program, which includes regular on-board inspections. USCG coordinates with California's State Lands Commission, manager of the state's ballast water program. In 2004, USCG issued "Ballast Water Management for the Control of Aquatic Nuisance Species in the Waters of the United States," a guidance document concerning ballast water management.

USCG activities related to AIS are diverse. The agency is working on the development of chemical and engineering methods to verify that a mid-ocean ballast water exchange has occurred. It is also evaluating technologies for the treatment of ballast water. USCG has determined that due to difficulties in establishing the effectiveness of ballast water exchange as it varies across ship types, voyages and from tank to tank, treatment technologies are best evaluated through a ballast water discharge standard (a benchmark for maximum numbers of organisms that may be discharged in ballast water). Such a standard will not only be helpful in evaluating the effectiveness of treatment technologies but also clearly establish when the ballast water no longer contains quantities of organisms that pose a significant risk. A Programmatic Environmental Impact Statement, detailing the evaluation of environmental impacts to the U.S. by several potential ballast water discharge standard alternatives, is currently in development.

USCG has also initiated several projects designed to provide information on the state of development of treatment technologies and the basic characteristics of treatment processes. These efforts have included scientific audits that tested and evaluated three approaches: filtration, ultraviolet light and hydro cyclonic separation. In addition, USCG developed and launched the Shipboard Technology Evaluation Program (STEP) in 2004 to encourage ship owners and operators to participate in evaluating technologies for shipboard application (see also CAISMP Action 7C3). This program allows for the review of experimental plans and treatment technology installations aboard ships. If they perform largely as designed and show promise for reducing the risk of introductions, treatment technology installations will be granted an equivalency with regulations for ballast water management and the Ballast Water Discharge Standard.

U.S. Department of Agriculture (USDA)

<http://www.aphis.usda.gov/>

<http://www.ars.usda.gov/main/main.htm>

<http://www.invasivespeciesinfo.gov>

USDA provides leadership on food, agriculture, natural resources and related issues. USDA conducts a number of programs and activities related to invasive species. USDA's Animal and Plant Health Inspection Service's (APHIS) deals with invaders like the South American wetland rodent, nutria, in the Mississippi Delta region and has also worked on other invasive animal, fish and crab problems around the country. APHIS has done extensive noxious weed work, including exclusion, permitting, eradication of incipient infestations, surveys, data management, public education, and (in cooperation with other agencies) integrated pest management of introduced weeds, including biological control. Aquatic weeds are included in the federal noxious weed list through the APHIS Cooperative Agricultural Pest Survey (CAPS).

The USDA's Agricultural Research Service (ARS) has three Exotic and Invasive Weed Research (EIWR) units in the west: at Davis and Albany, California, and at Reno, Nevada. Scientists at these facilities are responsible for research, the transfer of technology for improvement of management and control, and eradication of invasive aquatic and riparian weeds affecting agriculture and natural resources. These projects address three current ARS program priorities: 1) the reduction of dependence on pesticide use (specifically herbicides); 2) implementation of Executive Order 13112 (see above subsection on this order); and 3) water-quality improvement.

Research is conducted on the biology, reproduction, ecology, management or eradication of several important invasive aquatic weeds. The program provides technology transfer for the eradication and management of several problem species. The EIWR units are also involved in aquatic and riparian weed education for public, state and federal stakeholders.

U.S. Environmental Protection Agency (USEPA)

http://www.epa.gov/owow/invasive_species

USEPA leads the nation's environmental science, research, education and assessment efforts. It develops and enforces regulations, offers financial assistance, performs environmental research, sponsors voluntary partnerships and programs, furthers environmental education and publishes information. USEPA is responsible for enforcing the Clean Water Act (CWA). USEPA released its *EPA Authorities for Natural Resource Managers Developing Aquatic Invasive Species Rapid Response and Management Plans* in December 2005. This document provides an overview of USEPA authorities that apply to state or local AIS rapid response and control actions. The document summarizes relevant sections of the CWA and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA); summarizes how to apply for CWA Section 404 permits to discharge dredged or fill material; summarizes how to apply for FIFRA Section 18 emergency exemptions and FIFRA Section 24(c) special local need registrations; and describes case studies in which state and local natural resource managers successfully obtained FIFRA emergency

exemptions and special local need registrations for AIS eradication or control actions.

Within USEPA, there are three members of the National Estuary Program in California whose activities encompass AIS management.

National Estuary Program (USEPA – NEP)

<http://www.epa.gov/nep>

San Francisco Estuary Project: <http://www.abag.org/bayarea/sfep/sfep.html>

Morro Bay National Estuary Program: <http://www.mbnep.org/index.php>

Santa Monica Bay Restoration Commission: <http://www.santamonibay.org/>

Congress established the National Estuary Program in 1987 to protect and improve the water quality and natural resources of estuaries nationwide. There are three programs in California. The San Francisco Estuary Project (SFEP) was formed in 1987 as a cooperative federal/state/local program to promote effective management of the San Francisco Bay-Delta Estuary, and created a consensus-based management plan for the Estuary including concrete actions related to invasive species. More recently, SFEP identified invasive species as the number-one priority issue in estuary restoration. SFEP holds an ex officio seat on the ANSTF and is a member of the Western Regional Panel.

The Morro Bay National Estuary Program was established in July 1995. The estuary contains the most significant wetland system along California's south-central coast. It supports many species of internationally-protected migratory birds, offers rare wetland habitat to a number of threatened native plant and animal species, and provides a protected harbor for marine fisheries. There are plans to suppress or eliminate at least two aquatic invasive species present in the estuary: giant cane and Sacramento pikeminnow. Efforts to eliminate a pioneer population of giant cane growing along Chorro Creek, a major estuary waterway, and its tributaries, are ongoing; eradication is expected by 2008. Efforts to suppress the pikeminnow to the point where native steelhead populations can begin recovery are expected to begin in 2007.

The Santa Monica Bay Restoration Project was established in 1988 to ensure the long-term health of the 266-square-mile Santa Monica Bay and its 400-square-mile watershed. In 2003, this project became an independent state organization, the Santa Monica Bay Restoration Commission. In terms of invasives, the commission has focused most recently on coastal bluff, wetland and riparian vegetation, funding extensive removal and replanting programs as well as outreach on "California friendly" gardens. The newest threat is the arrival of the New Zealand mudsnail in some Santa Monica mountains streams. The commission has convened experts to strategize how to slow the snail's spread.

U.S. Fish and Wildlife Service (USFWS)

<http://www.fws.gov/>

<http://www.100thmeridian.org>

USFWS has multiple programs that address AIS management. USFWS serves as co-chair of the Federal ANSTF and is the agency that provides federal funding for the implementation of Task Force approved state AIS management plans. USFWS also provides technical assistance to states regarding AIS management. USFWS administers the Lacey Act, which prohibits importation and interstate delivery of listed species. USFWS prevention programs include the 100th Meridian Initiative (see Appendix D), which focuses on preventing the western spread of zebra mussels. In cooperation with the ANSTF, the USFWS has developed planning documents for Chinese mitten crab, European green crab, New Zealand mudsnail and *Caulerpa*. USFWS refuges support invasive species control programs as part of their overall habitat restoration activities.

U.S. Geological Survey (USGS)

<http://www.usgs.gov>

<http://nas.er.usgs.gov/>

USGS acknowledged its role in non-native species management in a White Paper on Invasive Species, which identifies the goal of developing new strategies for the prevention, early detection and prompt eradication of new invaders. The USGS further identifies information management and documentation of invasions as a priority for the agency. In keeping with this objective, the USGS developed and maintains an extensive, spatially referenced database of non-native species, which is accessible online.

APPENDIX C: STATE AUTHORITIES, LEGISLATION & AGENCIES

In California, many state agencies have authority over and regulatory roles for managing natural resources. While diverse agencies have some authority to regulate AIS, there has been no centralized authority or management structure to coordinate AIS activities before this plan. The legal frameworks that apply to control of aquatic invasive species introductions are broad and varied. This section describes the existing authorities that various state agencies and entities have for managing AIS in California, and overlaps somewhat with information presented in Chapters 4 and 5. For help with acronyms, see the Acronym Glossary in the introductory pages of this plan.

CALIFORNIA AUTHORITIES

California Environmental Quality Act (CEQA) (CA Public Resources Code §§ 21000 et seq.)

<http://ceres.ca.gov/ceqa/>

The California Environmental Quality Act (CEQA) requires public disclosure of all significant environmental effects of proposed discretionary projects. If a project would cause significant effects, final documents in the CEQA process show: 1) what mitigation measures will be required to reduce particular effects to a less significant level; and 2) provide justifications for the approval of the project with particular significant effects left unmitigated (i.e. a finding of overriding consideration). CEQA also contains lists of project types exempt from this process. A “significant” impact is a “substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, [and] fauna . . .”. The documented adverse impacts associated with invasive species can fit this broad definition.

California Porter-Cologne Water Quality Control Act (CA Water Code §§ 1300 et seq.)

http://www.swrcb.ca.gov/water_laws/docs/portercologne.pdf

Under California’s Porter-Cologne Water Quality Control Act, “any person discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the state” must file a report of the discharge with the appropriate Regional Water Quality Control Board (RWQCB). Pursuant to the act, the RWQCB then prescribes “waste discharge requirements” related to control of the discharge. The act defines “waste” broadly, and the term has been applied to a diverse array of materials. The San Francisco Bay RWQCB, for example, has determined that “ballast water and hull fouling discharges cause pollution as defined under the Porter-Cologne Water Quality Control Act.”

The act, (California Water Code, Division 7), lists a number of types of pollutants that are subject to regulation by the State Water Resources Control Board (SWRCB). Section 13050, for example, specifically includes the regulation of “biological” pollutants by defining them as relevant characteristics of water quality subject to regulation by the Board: AIS are an example of this kind of pollutant if they are discharged to receiving waters. The SWRCB also regards the application of pesticides to control AIS in waters of the state as a discharge of a pollutant requiring an NPDES permit. Several of the Regional Boards have taken legal policy and enforcement actions related to AIS (see also CWA in Appendix B and SWRCB in California Agencies).

Fish and Game Code and Title 14 of the California Code of Regulations

<http://www.fgc.ca.gov/html/regs.html>

<http://www.dfg.ca.gov/ospr/organizational/scientific/exotic/exotic%20report.htm>

The Fish and Game Code consists of the laws passed by the state legislature that pertain to fish and wildlife resources. Under statutes in the Fish and Game Code, the California Fish and Game Commission has the responsibility for the adoption of regulations that provide details on how certain Fish and Game laws are to be implemented. These regulations are published in Title 14 of the California Code of Regulations. A summary is provided below of Fish and Game Code Sections that address invasive species issues or may relate to control actions.

F & G Code §§ 2080 – 2089 DFG regulates the take of species listed under the California Endangered Species Act. In addition to the instructions in the Fish and Game Code, guidelines for this process are located in Title 14, Division 1, Subdivision 3, Chapter 6, Article 1 of the California Code of Regulations. These statutes and regulations should be consulted if AIS control measures have the potential to impact State-listed species.

F & G Code §§ 2118, 2270-2300: DFG is responsible for enforcement of importation, transportation and sheltering of restricted live wild animals; places importation restrictions on aquatic plants and animals; and prohibits nine species of *Caulerpa*.

F & G Code §§6400-6403: It is unlawful to place live fish, fresh or saltwater animals or aquatic plants in any waters of this state without a permit from DFG.

F & G Code §§15000 et seq.: DFG is responsible for regulations pertaining to the aquaculture industry, including disease issues.

Harbors & Navigation Code

The Harbors & Navigation Code, Article 2, Section 64, authorizes the Department of Boating and Waterways to manage aquatic weeds affecting the navigation and use of the state's waterways.

Ballast Management for Control of Nonindigenous Species Act (AB 703) of 1999

This act charged the California State Lands Commission (SLC) with oversight of the state's first program to prevent nonindigenous species (NIS) introductions through the discharge of ballast water from commercial vessels of over 300 gross registered tons (GRT). The 1999 act required that vessels originating from outside the United States Economic Exclusive Zone (U.S. EEZ) carry out mid-ocean exchange or use an approved ballast water treatment method, before discharging in California state waters. The SLC was tasked with: receiving and processing ballast management reports from all such vessels, monitoring ballast management and discharge activities of vessels through submitted reports, inspecting vessels for compliance and assessing vessel reporting rates and compliance. The activities and analyses of the first few years of the program are detailed in the 2003 biennial report of the California Ballast Water Management Program. Upon the sunset of the act, the Marine Invasive Species Act (AB 433) was passed in 2003, revising and widening the scope of the program to more effectively address the invasion threat (see below).

**Marine Invasive Species Act (AB 433) of 2003
(Public Resources Code, Sections 71200-71271;
Title 2, California Code of Regulations, Section 2271)**

The Marine Invasive Species Act, passed in 2003, revises and recasts the state's law pertaining to control of nonindigenous species and ballast water management (AB 703). It imposes additional requirements upon vessel masters, owners, operators and persons in charge of vessels to prevent the introduction of nonindigenous species into waters of the state or waters that may impact the waters of the state. The bill deletes exemptions for specified vessels from compliance with the act and revises the qualifications for the vessels subject to the act.

Ballast water management is required of all vessels greater than 300 gross registered tons (GRT) that intend to discharge ballast water in California waters, though the regulations differ depending on voyage origin. All qualifying vessels coming from ports within the Pacific Coast region must conduct near-coast exchange (in waters at least 50 nautical miles offshore and 200 meters deep) or retain all ballast water and associated sediments. There are exceptions that address safety concerns and for vessels that transit wholly within defined shared waters (San Francisco/-Stockton/Sacramento Delta, and Los Angeles/Long Beach/EI Segundo Complex).

All vessels must complete and submit a ballast water report form upon departure from each port of call in California. They must also comply with the good housekeeping practices, ranging from avoiding discharge near marine sanctuaries to rinsing anchors and removing fouling organisms from the hull. They must maintain a ballast water management plan prepared specifically for the vessel; keep a ballast water log outlining ballast water management activities for each ballast water tank on board the vessel, and make the separate ballast water log available for inspection; conduct training of vessel master, person in charge, and crew regarding the application of ballast water and sediment management and treatment procedures; and pay a fee for each qualifying voyage at their first port of call in California.

In addition to requirements imposed upon vessels operating in state waters, the SLC was charged with the development of several legislative reports offering policymaking guidance on commercial vessel AIS issues including: a Report on Commercial Vessel Fouling in California, Analysis, Evaluation and Recommendations to Reduce Nonindigenous Species Release from the Non-Ballast Water Vector; a Report on Performance Standards for Ballast Water Discharges in California Waters; and a Report on the California Marine Invasive Species Program. These efforts have resulted in the development of regulations to stem transport of AIS in the ballast water of vessels operating with the Pacific Coast Region; and legislation directing SLC to adopt regulations on performance standards for ballast water discharges.

Finally, the legislation also requires DFG to conduct a series of biological surveys to monitor new introductions to coastal and estuarine waters of the state and to assess the effectiveness of the management provision of the Act. AB 703, passed in 1999, required a baseline survey of the state's ports, harbors and bays. AB 433 expanded the baseline to include outer coast sites and required continued monitoring of all sites to determine if the ballast control measures have been successful in reducing the number of new introductions.

**Coastal Ecosystems Protection Act of 2006
(Public Resources Code, Sections 71204.7 – 72423)
(Revenue and Taxation Code, Section 44008)**

The Coastal Ecosystems Protection Act, passed in 2006, adds to the state's law pertaining to the discharge of ballast water (AB 433). It requires the SLC to adopt regulations that require an owner or operators of a vessel carrying, or capable of carrying, ballast water that operates in the waters of the state to implement certain interim and final performance standards for the discharge of ballast water.

California Ocean Protection Council Strategic Plan

http://resources.ca.gov/copc/strategic_plan.html

<http://resources.ca.gov/copc>

The California Ocean Protection Council, formed to coordinate the activities of ocean-related state agencies and improve state efforts to protect ocean resources, among other mandates (see California State Agencies), adopted a five-year strategic plan in 2006. The strategic plan supports the completion and implementation of both the state rapid response plan and this California Aquatic Invasive Species Management Plan, as well as the California Noxious and Invasive Weed Action Plan.

Delta Protection Act

www.delta.ca.gov

California's 1992 Delta Protection Act recognizes the natural resource significance of the 738,000 acre-Sacramento-San Joaquin Delta. The act seeks to preserve and protect Delta resources for the use and enjoyment of current and future generations and recognizes the threat posed by urban encroachment to the Delta's agriculture, wildlife habitat and recreation uses. Pursuant to the Act, a Land Use and Resource Management Plan for the Primary Zone (Management Plan) was completed and adopted by the Commission in 1995. The Management Plan sets out findings, policies and recommendations resulting from background studies in the areas of environment, utilities and infrastructure, land use, agriculture, water, recreation and access, levees and marine patrol boater education/safety programs. As mandated by the act, the policies of the Management Plan are incorporated in the General Plans of local entities having jurisdiction within the Primary Zone. Some of the plan sections relevant to AIS management include: Environment, Finding 8 and Recommendations 3 & 4; Water, Policy 2; and Marine Patrol, Boater Education & Safety, Policy 6 (see also Delta Protection Commission, Appendix D).

CALIFORNIA STATE AGENCIES

San Francisco Bay Conservation and Development Commission (BCDC)

<http://www.bcdc.ca.gov/>

The Bay Conservation and Development Commission is dedicated to the protection and enhancement of San Francisco Bay and to the encouragement of the Bay's responsible use. Any person or government agency wishing to place fill, extract materials or make any substantial change in use of any water, land or structure within the area of the Commission's jurisdiction requires a Commission permit or federal consistency determination. The Commission's jurisdiction includes San Francisco Bay, including tidal flats, subtidal areas and marshlands lying between mean high tide and five feet above mean sea level and a 100 foot shoreline band measured inland from the Bay shoreline, as defined by Section 66610 of the McAtteer-Petris Act. The Commission recognizes the threat of non-native invasive species to the Bay's ecosystem and the *San Francisco Bay Plan* contains policies regarding the monitoring, control and eradication of aquatic invasive species in the Bay.

California Department of Boating and Waterways (DBW)

<http://www.dbw.ca.gov/>

DBW works to help develop convenient public access to California waterways, promote on-the-water safety and keep waterways free of navigational problems. General activities include boating law enforcement, boater education, improvements to boating facilities and vessel sewage management. In addition, DBW manages the state's largest and oldest aquatic weed control program, working with other public agencies to control water hyacinth, and more recently Brazilian elodea, in the Sacramento-San Joaquin Delta, its tributaries and the Suisun Marsh. DBW also leads the California Clean Boating Network, a collaboration of government, business, boating and academic organizations working to increase and improve clean boating education efforts, including invasive species education, across the state.

California Coastal Commission (CCC)

<http://www.coastal.ca.gov/>

The CCC is mandated to protect and enhance public access, recreation, wetlands, visual resources, agriculture, commercial activity, industrial activity and environmentally sensitive habitats within the coastal zone through coastal development permits, local coastal programs and federal consistency review. The CCC has responsibility to protect both the biology of aquatic ecosystems and the special uses associated with the marine environment, such as commercial fishing and recreation. The CCC regulates development activities in state waters under its coastal development permit authority and is responsible for working with local governments within the coastal zone. The CCC is also the designated coastal management agency administering the federal Coastal Zone Management Act (CZMA) over Pacific waters offshore of California (outside of San Francisco Bay). As such, the Coastal Commission exercises federal consistency review authority over all federal activities and federally licensed, permitted or funded activities affecting the coastal zone, regardless of whether the activity occurs within, landward, or seaward of the coastal zone boundary. Federal agency activities, including permits and plans, are subject to the consistency determination process, and must be "consistent to the maximum extent practicable" with the state's coastal management program, in this case, the Chapter 3 policies of the California Coastal Act (15 CFR § 930.32).

California Department of Fish and Game (DFG)

<http://www.dfg.ca.gov/>

<http://www.dfg.ca.gov/ospr/>

DFG has jurisdiction over the conservation, protection and management of fish, wildlife, plants and habitat necessary for biologically sustainable populations of those species. DFG conducts a number of programs related to aquatic invasive species, including serving as the lead agency in developing this statewide AIS management plan, as well as a rapid response plan for invasions (see Appendix A). DFG is responsible for enforcement of regulations concerning the aquaculture industry; the importation and transport of live wild animals, aquatic plants and fish into the state; and the placement of any such animals in state waters. The agency is also responsible for conducting biological surveys to assess the amount and types of AIS present in state waters, and the degree of success of ballast water management activities. Starting in 1999 with ballast management legislation, these surveys have been undertaken by DFG's Office of Spill Prevention and Response (DFG/OSPR). DFG/OSPR also manages the California Aquatic Non-Native Organism Database (CANOD) and is working to establish consistency among the various major databases being used to analyze similar types of AIS-related information. Lastly, DFG has been an active manager or partner in numerous AIS eradication and control programs, especially for those AIS that threaten at-risk species or the conservation and restoration of aquatic or riparian ecosystems.

California Department of Food and Agriculture (DFA)

<http://www.cdffa.ca.gov/>

DFA is the lead agency for regulatory activities associated with aquatic weeds. This regulatory authority includes quarantine, exterior pest exclusion (border protection stations and inspections), interior pest exclusion (pet/aquaria stores, aquatic plant dealers and nurseries) and detection and control/eradication programs. In addition, the DFA Plant Pest Diagnostic Center identifies plant species and assigns plant pest ratings. DFA maintains a rated list of noxious weed species. "A"-rated pests require eradication, containment, rejection or other holding actions at the state-county level. Quarantine interceptions are to be rejected or treated at any point in the state. For "B"-rated pests, eradication, containment, control or other holding actions are taken at the discretion of the agricultural commissioner. State-endorsed holding actions and eradication of "C"-rated pests occur only when these pests are found in a nursery. Action is taken to retard spread outside of nurseries at the discretion of the commissioner. Rejection occurs only when found in a crop seed for planting or at the discretion of the commissioner. "Q" ratings are temporary "A" ratings pending determination of a permanent rating. DFA is also responsible for the *Hydrilla* eradication program (see Chapter 2).

County Agricultural Commissioners (CACs)

<http://www.cdffa.ca.gov/exec/cl/cacasa.htm>

CACs have long been at the forefront in the battle against invasive species throughout the state. They work collaboratively with DFA and other agencies to exclude, detect and eradicate or manage a wide range of pest species. CACs perform numerous inspections of incoming plant materials, checking for compliance with quarantine requirements and for noxious weeds and other pests. Nurseries and pet stores are also inspected. The CACs have worked with DFA to obtain additional resources to fund more effective programs. Once plant materials enter the state, it is generally the CACs who perform inspections and carry out most of the weed eradication and management activities. While the CACs are not a "state" agency, they form a statewide system, represented at the state level by California Agricultural Commissioners and Sealers Association (CACASA) and have specific authorities granted by state law to carry out pest prevention programs.

California Department of Parks and Recreation (PARKS)

<http://www.parks.ca.gov/>

PARKS manages more than 270 park units and approximately 1.4 million acres, of which more than 280 miles is coastline and 625 miles of lake and river frontage. Management objectives of individual properties within the system depend on a unit's classification and range from a preservation mandate to a recreation emphasis. Units of the state park system can be established in either the terrestrial or underwater environment. Management to restore natural processes is basic to many types of state park units. This management includes removal of exotic species and is expected to extend below the waterline in units that are primarily terrestrial.

California Department of Pesticide Regulation (DPR)

<http://www.cdpr.ca.gov/>

DPR is vested with primary responsibility to enforce federal and state pesticide laws and regulations pertaining to the proper and safe use of pesticides in California. The Department regulates pesticides under a comprehensive program that includes enforcement of pesticide use in agricultural and urban environments, prevention of environmental contamination, environmental monitoring for emergency eradication projects and other related functions. DPR conducts monitoring of emergency eradication projects to ascertain that the public and the environment are being protected and the correct amounts of pesticides are being applied. DPR conducts sampling in consultation with the County Agricultural Commissioners, Department of Fish and Game, the RWQCBs and other stakeholders. DPR works cooperatively with other government agencies sharing information and monitoring results.

California Department of Water Resources (DWR)

<http://www.water.ca.gov/>

DWR addresses invasive species issues that impact water supply, water delivery and flood control. In general, DWR administers programs involving flood control for the Central Valley, dam safety for more than 1,200 dams statewide, design and construction of water facilities, water quality improvement and water supply data collection and studies. DWR also operates and maintains the State Water Project (SWP).

Recent activities related to invasive species are diverse. DWR conducts monthly monitoring of benthic (bottom-dwelling) invertebrates, zooplankton and phytoplankton throughout the upper San Francisco Estuary and reports trends in invertebrate abundance and community composition, including newly introduced species, to the State Water Resources Control Board. DWR is documenting the distribution of the invasive algal species *Microcystis spp.* in the upper San Francisco Estuary, investigating which strains (toxic versus non-toxic) are present and examining effects on the aquatic food web. DWR is also investigating the impacts of the Chinese mitten crab on the benthic invertebrate community in the Sacramento-San Joaquin Delta and co-authored a white paper on its life history.

On the prevention front, DWR implemented the California Zebra Mussel Watch Program until June 2005 (which included risk assessment, early detection, public outreach, the development of a rapid response plan for the Central Valley watershed and a centralized reporting system for mussel sightings). The future of this program depends on funding. At Lake Davis, DWR has been coordinating with DFG on northern pike control and downstream protection (including the installation of a structure to prevent pike escape over the dam). DWR contributes to programs aimed at controlling invasive weeds along eroding Sacramento River banks, within flood control and water conveyance structures and along urban streams. The agency coordinates its activities with other state and federal agencies as a member of the CALFED Non-native Invasive Species Advisory Council (NISAC).

California Ocean Protection Council (OPC)

<http://www.coastalconservancy.ca.gov/>

The OPC, created in 2004, is a state cabinet level council consisting of the Secretaries for Resources and the California Environmental Protection Agency, the chair of the State Lands Commission and two members of the Legislature. The OPC is a policy making body and also prioritizes the expenditure of various funds appropriated to other State departments for ocean protection purposes. The OPC has authorized funding for the completion of this AIS plan and is considering inclusion of implementation of this plan in its strategic plan as a major objective over the next five years. OPC's policies are administered by the Coastal Conservancy with direction from an Executive Policy Officer housed at the Resources Agency.

California State Lands Commission (SLC)

<http://www.slc.ca.gov>

SLC manages the mandatory, statewide, multi-agency Marine Invasive Species Program. This program works to implement regulations governing ballast water management for vessels operating on the West Coast of North America. Commission inspectors board approximately 25% of all vessels that arrive in California to verify compliance with regulations and to disseminate outreach materials to vessels and crews new to California. In addition to its regulatory activities, the Commission facilitates scientific research and technology development to enhance management efforts of the program and to inform policymakers. Limited funding is provided for research that targets priority information gaps and to technologies that show exceptional promise for the treatment of ballast water. In recent years, the SLC has also prepared a number of reports for the state legislature documenting commercial vessel fouling in California, proposing performance standards for ballast water discharges, and summarizing vessel ballast water activities and compliance in California (see also Ballast Water Management, California Authorities, and Chapter 5). In addition to the mandated Marine Invasive Species Program, the SLC has been coordinating interagency efforts to manage invasive aquatic plants such as Eurasian watermilfoil in Lake Tahoe (see Case Study, Chapter 8).

State Coastal Conservancy (SCC)

<http://www.coastalconservancy.ca.gov/>

SCC has been involved for over twenty years in the control and eradication of aquatic invasives, pursuant to Division 21 of the Public Resources Code. SCC developed, funded and operates the Invasive *Spartina* Project in San Francisco Bay that shows great promise in eradicating nonindigenous species of *Spartina* and their associated hybrids. SCC is also involved in efforts to control *Arundo* in many coastal watersheds. SCC directly develops projects and provides grant funds related to resources enhancement and restoration, including control and elimination of invasives. SCC is also a partner in developing this management plan.

The San Francisco Estuary Invasive *Spartina* Project (ISP)

<http://www.spartina.org/>

SCC established the ISP in 2000. Its overall goal is to develop and implement a regionally coordinated project to eradicate the four introduced and highly invasive *Spartina* species in the San Francisco Estuary. The ISP is comprised of a number of components, including outreach, research, permitting, mapping, monitoring and allocation of funds for efforts to eliminate populations of nonindigenous *Spartina*. In 2005 the Conservancy and ISP began full-scale implementation of the regionally coordinated *Spartina* Control Program (SCP), employing an aggressive treatment strategy to target nearly all infested sites in the San Francisco Estuary. Initial results show on average about 85% efficacy at treated sites. SCC will continue to coordinate the regional control effort through the ISP, and to allocate funds to land owners and managers around the San Francisco Bay for aggressive treatment activities consistent with the SCP. If funding

continues, it's expected that invasive *Spartina* will be effectively eradicated from the San Francisco Estuary between 2009 and 2011 (see also Case Study, Chapter 8).

State Water Resources Control Board (SWRCB)

<http://www.swrcb.ca.gov/>

The SWRCB's mission is to preserve, enhance and restore the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations. The Board has joint authority over water allocation and water quality protection. Under the State Board are nine Regional Water Quality Control Boards (RWQCBs). The SWRCB and regional boards have been working in support of, and in an advisory capacity to, other state agencies on various AIS activities, such as hull fouling and ballast water management. Invasives come under water board purview as part of the state's efforts to implement and enforce the Clean Water Act (CWA, see also Appendix B). A 2005 federal court ruling defined non-indigenous species as "pollutants" present in discharges from vessels and found that such discharges are not exempt from permitting requirements (NPDES, see also CWA, Appendix B).

In terms of AIS management activities, some of the regional boards have also sought to place specific water bodies within their regions on the CWA's 303(d) list, as impaired by exotics. S.F. Bay was listed in 1998. In 2006, the State Board placed the Delta, the Cosumnes River and a portion of the San Joaquin River on the 303 (d) list. Once on the 303(d) list, the regional boards are required to develop discharger/source based programs for managing pollutants, including the determination of "total maximum daily loads" (TMDLs)), which in the case of exotics have proved somewhat difficult to develop. Trying to allocate loads or goals for zero loads, among dischargers, water users and municipalities is challenging when most of the water bodies in question are already heavily invaded. Despite the implementation challenges, the S.F. Bay Water board's work on the state's first exotics TMDL did, however, widely publicize the problem and led to other successful AIS management and legislative programs.

Other regional boards have become involved in AIS-related water quality issues through watershed management projects, non-point source pollution management programs and wetland mitigation and restoration programs (raising issues about the use of non-native aquatic plant species for these programs, and the control of invasives, for example). The State Board has also participated in AIS management activities concerning the use of aquatic pesticides.

University of California (UC)

www.universityofcalifornia.edu

www.ipm.ucdavis.edu/

UC conducts extensive research on invasive species issues and has a substantial pool of scientists devoted to biological invasions and management. UC faculty serve on NGO, and state and federal government panels and committees charged with invasive species management. They also provide expertise and management for a variety of cooperative government units such as UC's Division of Agricultural and Natural Resources' (ANR) Integrated Pest Management Program and the Center for Invasive Species Research (UC Riverside). This center has managed the Exotic Species Research Program for USDA for almost five years. UC ANR also has Marine Advisors in most coastal counties in the state as part of the Sea Grant extension program. This provides a direct academic presence for extension outreach and applied research collaboration with agencies and campus faculty (see also National Sea Grant, Appendix B). UC also has formal graduate training programs on invasive species, such as the Integrative Graduate Education and Research Traineeship, based at UC Davis, in which the students intern with DFG, USFWS and other government agencies.

APPENDIX D: OTHER AIS INTERESTS

COORDINATING COMMITTEES, EDUCATIONAL INITIATIVES & SPECIAL INTEREST GROUPS

AIS spread across so many jurisdictions and impact so many different types of human activities and environmental priorities that diverse efforts have been made to promote coordination among AIS-involved agencies, organizations and stakeholders. Some of these, such as CALFED or the Western Regional Panel serve important functions in implementing federal and state mandates for coordination. Others provide ongoing forums for information sharing and priority setting among different agencies, organizations and interest groups, or among those attempting to restore or preserve specific waterways.

COORDINATING COMMITTEES & PARTNERSHIPS

Aquatic Nuisance Species Task Force

www.anstaskforce.gov

Federal legislation established the national Aquatic Nuisance Species Task Force (ANSTF), co-chaired by the USFWS and NOAA. ANSTF is charged with coordinating governmental efforts related to ANS prevention and control. ANSTF consists of 10 federal agency representatives and 12 ex officio members representing nonfederal governmental agencies.

Adopt-A-Riverway Program

This program is a government-volunteer partnership established in 2003. Participation in the program includes management of noxious and invasive weeds. Authorized program activities include planting and establishing native seedling trees, shrubs, native grasses, wildflowers, and removing litter and weeds, consistent with an integrated weed management plan. AB 66, a state bill, established an Adopt-A-Riverway Fund for proceeds donated, appropriated, transferred or otherwise received for purposes pertaining to the Adopt-A-Riverway Program.

Association of Fish and Wildlife Agencies (AFWA)

<http://www.fishwildlife.org/>

AFWA represents the government agencies responsible for North America's fish and wildlife resources. It promotes sound management and conservation and speaks with a unified voice on important fish and wildlife issues. AFWA was awarded a recent grant to create communications strategies on issues related to unwanted invasive aquatic species. This project will help states develop comprehensive programs to address aquatic nuisance species issues within their states and will collectively help the Regional Associations and the AFWA nationally develop a stronger voice and greater capabilities when addressing regional and national aquatic nuisance species efforts.

CALFED Bay-Delta Program (CALFED)

<http://calwater.ca.gov/>

CALFED is a cooperative effort of more than 20 state and federal agencies working with local communities to improve the water quality and reliability of California's water supplies and restore the San Francisco Bay-Delta ecosystem. One goal of CALFED's Ecosystem Restoration Program (ERP) has been to "prevent establishment of and reduce impacts from non-native species." The goal includes 10 specific objectives, such as eliminating further introductions of new species in ballast water of ships and preventing the invasion of the zebra mussel into California. CALFED has also developed a strategic plan for managing non-native invasive species in the San Francisco Bay-Delta Estuary and the Sacramento and San Joaquin Rivers and associated watersheds. To date, CALFED has funded 31 projects that address preventing the establishment of, or reducing the impacts from, non-native invasive species in California.

CALFED also created a Non-native Invasive Species Advisory Council (NISAC), a council of agency and technical stakeholders to advise the program on non-native invasive species.

California Horticultural Invasives Prevention (Cal-HIP)

www.suscon.org/invasives

This partnership develops strategies to reduce introductions of invasive plants through horticulture. Partners include environmental NGOs, agency representatives, and nursery and landscaping trade organizations. Sustainable Conservation, a nonprofit organization, facilitates the partnership.

California Interagency Noxious & Invasive Plant Committee (CINIPC)

http://www.cdfa.ca.gov/phpps/ipc/CINWCC/cinwcc_hp.htm

This committee, formerly known as California Interagency Noxious Weed Coordinating Committee (CINWCC), was formed in 1995, with a memorandum of understanding among 14 federal and state agencies. The committee changed its name again in 2006. Its mission is to facilitate, promote and coordinate the establishment of an integrated pest management partnership between public and private land managers toward the eradication and control of noxious weeds on federal and state lands and on private lands adjacent to public lands.

California Invasive Plant Council (Cal-IPC).

www.cal-ipc.org

This Council is a nonprofit organization that works to protect California wild lands from invasive plants through research, restoration and education. Cal-IPC proposes and facilitates solutions to problems caused by invasive plants. Membership includes public and private land managers, ecological consultants, researchers, planners, volunteer stewards and concerned citizens. Cal-IPC is recognized as an authoritative source of new information on all aspects of wild land weed management.

California Invasive Weed Awareness Coalition (CALIWAC)

www.cal-ipc.org/policy/state/caliwac.php

This coalition, made up of primarily industry stakeholders, was formed in 2001 to increase awareness of the invasive weed issue in California. The coalition's goals are to support the development of a statewide management plan for invasive weeds; provide a public forum to increase awareness of the detrimental environmental and economic effects of invasive weeds and contribute to solutions for invasive weed issues; promote increased funding for management of invasive weeds; and influence state and national policy on invasive weeds

California Weed Science Society (CWSS)

<http://www.cwss.org/>

This Society was founded in 1948 to promote environmentally sound proactive research and develop educational programs in weed science; support undergraduate/graduate students seeking a career in weed science; and encourage and support educational activities to promote integrated weed management systems.

County Weed Management Areas (WMA)

A Weed Management Area (WMA) is a local organization that brings together landowners and managers (private, city, county, state, and federal) in a county, multi-county or other geographical area for the purpose of coordinating and combining action and expertise in combating common invasive weed species. The WMA Support Program in DFA provides coordination and training opportunities and allocates state funding earmarked for WMAs.

Delta Protection Commission (DPC)

www.delta.ca.gov

California's 1992 Delta Protection Act created a Delta Protection Commission in recognition of the natural resource significance of the 738,000 acre-Sacramento-San Joaquin Delta. The Act seeks to preserve and protect Delta resources for the use and enjoyment of current and future generations and recognizes the threat posed by urban encroachment to the Delta's agriculture, wildlife habitat and recreation uses (see also Appendix C, State Authorities). The 19-member Delta Protection Commission provides for stakeholder representation in the areas of agriculture, habitat, and recreation. A land use and resource management plan for the primary zone of the Delta, completed in 1995 and updated in 2002, acknowledges the impacts of exotic species on Delta resources and makes recommendations for preventing impacts on native fish, and on aquatic, channel island and seasonal wetland habitats (including mosquito abatement projects).

Pacific Ballast Water Group (PBWG)

<http://www.psmfc.org/ballast/>

This group was formed by representatives from the shipping industry, state and federal agencies, environmental organizations, and others who recognized the need for a cooperative and coordinated regional approach to ballast water management to prevent the introduction of invasive species on the West Coast. The PBWG meets regularly and is currently addressing the development of ballast water discharge standards and inter-jurisdictional issues related to ballast water management on the West Coast.

Pacific States Marine Fisheries Commission (PSMFC)

<http://www.psmfc.org/>

PSMFC is one of three interstate commissions dedicated to resolving fishery issues. Representation includes the states of California, Oregon, Washington, Idaho and Alaska. The PSMFC does not have regulatory or management authority; rather, it serves as a forum for discussion, works towards coast wide consensus on state and federal authorities and addresses issues that fall outside state or regional management jurisdiction. Over the past four years, the Pacific States Marine Fisheries Commission's AIS program has concentrated on four species of aquatic invaders: Chinese mitten crab, European green crab, zebra/quagga mussel and Atlantic salmon. Program activities include research and monitoring, educational outreach, interjurisdictional planning and coordination, and funding and contracting services for numerous partners.

Western Governors' Association

<http://www.westgov.org/>

The Western Governors' Association is developing a new program to address undesirable nonindigenous aquatic and terrestrial species in the west. In 1998, the Western Governors passed a resolution on Undesirable Aquatic and Terrestrial Species to develop and coordinate western strategies and to support management actions to control and prevent the spread and introduction of undesirable species; support the use of integrated pest management concepts; encourage broad-based partnerships; and urge adequate support for the U.S. Department of Agriculture's Animal and Plant Health Inspection Service. The Association has formed a working group of state and federal agencies, industry, non-governmental organizations and academia to develop western strategies to limit the spread of these species.

Western Regional Panel (WRP)

<http://www.fws.gov/answest/>

This panel on Aquatic Nuisance Species was formed as a committee of the ANSTF after the passage of NISA to help limit the introduction, spread and impacts of aquatic nuisance species into western North America. This panel includes representatives from federal, state, and local agencies, Native American tribes, and private environmental and commercial interests, as well as a representative from Canada.

The general goals of the WRP are to prevent nuisance species introductions, coordinate activities of the western states among federal, local and tribal agencies and organizations, and minimize impacts of already established nuisance species. The purposes of the WRP, as described in NISA, are to: identify western region priorities for responding to aquatic nuisance species; make recommendations to the ANSTF regarding an education, monitoring (including inspection), prevention, and control program to prevent the spread of the zebra mussel west of the 100th meridian; coordinate other aquatic nuisance species activities in the west not conducted pursuant to the act; develop an emergency response strategy for federal, state, and local entities for stemming new invasions of aquatic nuisance species in the region; provide technical assistance to public and private stakeholders for preventing and controlling aquatic nuisance species infestations; and submit an annual report to the ANSTF describing activities related to ANS prevention, research and control.

MAJOR NATIONAL EDUCATION CAMPAIGNS

100th Meridian Initiative, USFWS

<http://www.100thmeridian.org>

The primary goal of the 100th Meridian Initiative is to prevent the further spread of zebra mussels. At the time it was formed, the western limit of the zebra/quagga mussel roughly coincided with the 100th meridian. It is the first large-scale, cross-jurisdictional effort to combat the spread of an aquatic invasive species. Participating entities include federal, state, local and tribal governments, potentially affected industries such as commercial boat haulers and other stakeholders. The initiative has produced an extensive public information and education campaign aimed at marina users, anglers and recreational boaters. It sponsors the production of posters, informational flyers and signs educating boaters about the risks of zebra mussels and other AIS. Its members conduct voluntary boat inspections and boater surveys to identify boats at highest risk for harboring AIS. Collected boater travel patterns are being used to model potential pathways for the mussel's spread. The initiative has supported the establishment of mussel monitoring stations across the west, as well as the development of regional rapid response plans should the mussel establish new populations. Recent programs include the Lewis and Clark Initiative, a program aimed at increasing outreach efforts to recreational boaters retracing the path of the historic expedition during its bicentennial. Among other accomplishments, the effort resulted in the establishment of more AIS monitoring stations and a mussel monitoring database for the Columbia River Basin region.

Habitattitude

www.habitattitude.net

Habitattitude is an ANSTF collaboration of the Pet Industry Joint Advisory Council (PIJAC), the U.S. Fish & Wildlife Service, the NOAA National Sea Grant College Program, and the nursery and landscape industry. It was established in 2004 to educate aquarium hobbyists, backyard pond owners, water garden enthusiasts, and others on how to prevent the spread of potential aquatic nuisance species. Its web site includes information on how non-native fish and plants can harm ecosystems, suggests environmentally sound alternatives to releasing unwanted aquatic plants and animals in the wild and offers tips on how to prevent accidental releases. The site offers promotional materials, signage and decals for participating retailers and manufacturers. The initiative offers a means for industry and the USFWS to work together to promote their shared interests in preventing AIS impacts.

Stop Aquatic Hitchhikers

www.protectyourwaters.com

The Stop Aquatic Hitchhikers web site is part of the ANSTF public awareness campaign. It is sponsored by the USFWS and the USCG. It functions as a reputable, central source of information about aquatic nuisance species affecting the United States. Resources include photos and descriptions of common nuisance species, how they impact ecosystems, boaters and anglers, and tips for preventing their spread. A news page features stories from major news outlets as well as government news releases related to AIS. Video and audio clips geared toward traveler information centers are available for download as are outreach materials such as posters, flyers, stickers for tackle boxes, banners and signs. Clubs, state and government agencies, and private entities are encouraged to join the campaign and pledge to prevent the spread of AIS. In California, partners include the DFG, California Trout, the City of Davis, Heal the Bay (Santa Monica), and the Santa Ana Zoo, among others.

SPECIES- & PLACE-SPECIFIC COALITIONS, INITIATIVES & NONPROFITS

100th Meridian Initiative, USFWS

(see Major National Education Campaigns)

California Sea Grant

(see Appendix B, NOAA – Sea Grant)

Channel Islands National Marine Sanctuary

(see Appendix B, NOAA – NMS)

Cordell Banks National Marine Sanctuary

(see Appendix B, NOAA – NMS)

Elkhorn Slough National Estuarine Research Reserve

(see Appendix B, NOAA – NERR)

Gulf of the Farallones National Marine Sanctuary

(see Appendix B, NOAA – NMS)

Invasive Spartina Project

(see Appendix C, State Coastal Conservancy)

Lower Colorado River Giant Salvinia Task Force

<http://lcrsalvinia.org/salviniahome.asp>

On August 4, 1999, the USFWS found giant salvinia in the Imperial National Wildlife Refuge on the Colorado River. Plants were also seen floating down the Colorado River, on the Cibola National Wildlife Refuge, and in Pretty Water and Three Finger lakes. Subsequent investigation determined that the source of the infestation was the West Side/Outfall Drain of the Palo Verde Irrigation District near Blythe, California. To ensure a coordinated response to the infestation, a task force was formed. Teams focused on accomplishing steps to control and/or eradicate giant salvinia in the lower Colorado River. Teams address issues relating to research, monitoring, rapid response, field implementation, regulation and compliance, outreach, and financial and international issues.

Monterey Bay National Marine Sanctuary

(see Appendix B, NOAA – NMS)

Morro Bay National Estuary Program (USEPA National Estuary Program)

(see Appendix B, USEPA – NEP)

San Francisco Bay National Estuarine Research Reserve

(see Appendix B, NOAA – NERR)

San Francisco Estuary Institute

www.sfei.org/bioinvasions

SFEI was founded as a non-profit organization in 1986 to foster the scientific understanding needed to protect and enhance the San Francisco Estuary. It is governed by a board composed of Bay Area scientists, environmentalists, regulators, local governments and industries. SFEI's Biological Invasions program conducts scientific and policy research and provides information and analyses on the introduction of exotic organisms into marine and freshwater ecosystems. In the last decade, the program has been actively working to improve understanding and management of invasive species, to document the status of invasive species in San Francisco Bay and the increasing rate of invasions. The program is also involved in

helping develop regulatory standards for ballast water discharges. Most recently, SFEL is chairing the scientific advisory panel that is providing guidance from the research community to the government agencies responding to the recent discovery of quagga mussel in California and performing some of the research identified by the quagga mussel incident command.

San Francisco Estuary Project (USEPA National Estuary Program)

(see Appendix B, USEPA – NEP)

Santa Monica Bay Restoration Commission (USEPA National Estuary Program)

(see Appendix B, USEPA – NEP)

Southern California Caulerpa Action Team (SCCAT)

<http://www.sccat.net/>

SCCAT was established to respond quickly and effectively to the discovery of *Caulerpa* in Southern California. The group consists of representatives from local, state, and federal governmental entities and from private organizations. SCCAT's goal is to completely eradicate all infestations in Agua Hedionda Lagoon and Huntington Harbour and to prevent new infestations (see also Chapter 8, Case Study)

Tahoe Basin Weed Coordinating Group

(775) 784-4848

This group is coordinated through the University of Nevada Cooperative Extension to address the increasing aquatic weed problem in the two-state Lake Tahoe Basin. This group and local agencies have undertaken mechanical removal of Eurasian watermilfoil and efforts are now being expanded, incorporating a variety of removal methods (see also Case Study, Chapter 8).

Team Arundo

<http://www.sawpa.org/arundo/>

Team Arundo was formed in Orange County, California, in 1991 to control *Arundo* along the Santa Ana River, and has since become a statewide program. Chapters exist in the Bay Area, San Luis Obispo and surrounding counties, Greater Los Angeles County, and San Diego County.

Team Arundo Del Norte

<http://ceres.ca.gov/tadn/>

Team Arundo Del Norte is a forum of local, state and federal organizations dedicated to the control of *Arundo* in rivers, creeks and wetlands in Central and Northern California. The organization formed in the summer of 1996 and meets several times per year in the Sacramento area to explore opportunities for information exchange and partnerships in support of the ongoing work of eradicating *Arundo*.

Tijuana River National Estuarine Research Reserve

(see Appendix B, NOAA – NERRS)

APPENDIX E: AIS PLAN DEVELOPMENT & PROCESS

An initial draft of this plan was developed for DFG several years ago with stakeholder input (see below). At that time the plan was not completed due to funding and staffing issues. In 2006, additional funding was awarded to SFEP from the OPC, through the SCC, to finish and begin implementation of the plan.

2006 Draft & Final Plan Process

The 2006 draft of the plan incorporated much of the text, research and public comments provided by the original 2004 draft (see below).

In early 2006, agency staff reviewed the 2004 version and suggested updates. The resulting draft was circulated two times for review and comment by AIS program managers within lead state and federal agencies. Two internal meetings – one in June, and one in July – were held to discuss the draft and documented in meeting notes. Revisions were made accordingly.

The resulting draft plan was posted for public review on August 22nd, 2006. Three public meetings were held in August and September 2006 in Oakland, Sacramento and Long Beach to review the draft plan. Public comments were reviewed and incorporated to the extent possible.

Attendees at one or more of 2006 internal interagency meetings included:

Susan Ellis, DFG
Abe Doherty, SCC
Julie Horenstein, DFG
Dan Wilson, DFG
Paul Ryan, DBW
Geoff Newman, DBW
Terri Ely, DBW
Marian Ashe, DFG/OSPR
Jeffrey Herod, USFWS
Marcia Carlock, DBW
Suzanne Gilmore, SLC
Tanya Veldhuizen, DWR
Lynn Takata, SLC
Ben Becker, NPS
Karen McDowell, SFEP
Maurya Falkner, SLC
Pat Akers, DFA

2006 Public Meetings Summary

Background

A Draft AIS Plan was publicly released in late August 2006 and three public meetings were held in August and September to solicit input. The following pages summarize the presentation used at all three meetings and present comments and questions raised by meeting attendees. In addition, the results from a “prioritization” exercise conducted at each meeting are presented.

Meeting Overview

The meetings were called to order by Austin McInerny, facilitator, from the Center for Collaborative Policy, California State University, Sacramento. After McInerny provided an overview of the meeting agenda, participants and staff involved in preparing the Draft AIS Plan, introduced themselves. Project staff participating in the meetings included:

- Susan Ellis, Invasive Species Coordinator, DFG
- Julie Horenstein, DFG
- Karen McDowell, Project Coordinator, SFEP
- Abe Doherty, Project Manager, SCC
- Paula Trigueros, SFEP (note taker)
- Debbi Egter Van Wissekerke, SFEP (logistics manager)

Karen McDowell provided a brief background and overview of the plan’s development process and explained the need to complete the plan to qualify for federal funding. She further clarified that the plan is to provide a management framework for agency coordination and that the anticipated adoption timeline is very aggressive. She reviewed the required components of the plan and explained the proposed management framework and the Technical Advisory Panels. She highlighted the objectives, strategies and action items for implementation and noted the priority section would be completed following the public review process. She explained the appendices including the Rapid Response Plan. Next steps included posting updates on the website and including the public comments as an Appendix also to be posted on the web. The complete presentation is available online at:

http://sfep.abag.ca.gov/projects/invasive_species.html

Following the presentation, a short question and answer period was held to address questions on how the plan was developed. Then, meeting attendees provided feedback, comments, and questions regarding the Draft AIS Plan. Lastly, meeting attendees were asked to review the proposed Action Items proposed in the plan and identify what they believed were both “high” and “low” priority action items.

Comment forms were provided and copies of the Draft AIS Plan were available for review.

Public Meeting #1 (Sacramento) Summary

The meeting was held August 28 in the auditorium of the California Department of Food & Agriculture and had nearly 30 attendees. The following comments and questions were raised:

- Woody Schon, Sacramento/Yolo Mosquito & Vector Control District: Expressed concern with Action 2E4 regarding use of mosquito fish for mosquito control. His district uses fish to control mosquitoes in degraded habitats such as rice or agricultural fields that are not flowing into streams, rivers or vernal pools and does not want to see these fish excluded as a tool for mosquito control.
- Raynor Tsuneyoshi, Director, DBW: Would like to see Collaborative Center for AIS at a university. Concern with hull cleaning for small boats – it is 9 times more expensive to haul a boat out of the water for hull cleaning than to clean in the water. There is in-water technology for anti-fouling for large boats but not for small. Regarding cleaning stations, who would fund, and how would they be distributed around the state? Recommended the development of remedies for specific behaviors – fishing boats, trans-Pacific yacht racing. Recommends going slow to curtail copper based hull paint as it slows down hull fouling.
- Dave Breninger- General Manager Placer Co Water Agency; Director ACWA; Director RBOC: Concern with water quality issues (agricultural water and the delta). Need to link water agency and boating concerns (Objective 2I). His water district is plagued with non-natives. Need to eradicate in waterways. Likes use of native plants. Need to make recreational boaters part of the solution. *Egeria* should be eradicated. Need a positive way to put money into solution.
- Duane L. Schnabel, Primary State Biologist, DFA: Although the plan cites NEPA/CEQA in Appendix B there is no discussion of when an EIR will be done for the plan. People need to know if the actions will do more harm than good.
- Ted Grosholz, Dept. of Environmental Science & Policy, UC Davis: He is a cooperative extension researcher who developed the initial plan. The plan as written has an absence of university and research institution participation. The plan ignores non-agency participants in AIS work. Action 1A6 calling for a data base of AIS projects ignores already existing National Biological Species nodes at UC Davis and UC Santa Barbara. Actions 6A3-11 ignores cooperative extension and sea grant work in progress for years. Actions 7A1-2 to complete AIS studies ignores work under development at the universities. The plan needs to bring the University of California into the management plan. The Ocean Protection Council endorsed a university inter-agency center for AIS and the center is not included as part of this plan. The center needs to be part of the plan and needs to be stated explicitly.
- Rick Grosberg, Center for Population Biology, UC Davis: The threat of AIS was identified by the research community and not state agencies. The document completely ignores the contributions of the research community. UC Davis formed an AIS council that is not included or even mentioned. The management framework includes only agency leaders who will meet (When? For What?). The Document needs to integrate geographically and biologically. It does not provide a management framework for integration at all levels. There is a missing objective for coordination of research problems, ecological problems, biological problems; the structure for coordination is not listed as an objective. Document does a good job identifying problems but fails in coordination and development of policy.
- Rebecca Verity - UCOP: UCOP supports the University of California and CSU's disappointment at being left out of the plan. The state constitution designated the University of California as the research arm of the State of California. The university was

told there would be an AIS Center for coordination of research, surveys and development of new tools. All faculty were told the bones of the center would be in the management plan. They are very disappointed it is not.

- Jodi Cassell, Sea Grant: Has been involved in outreach and applied research on AIS. Jodi herself has been involved for 8 years. They are also a funding source having funded \$1,800,000 in AIS projects and outreach. They are very disappointed the plan ignores all non-state agency work related to AIS. Sea Grant is not mentioned at all in the plan although they have done extensive outreach on ballast water management, newsletters, research on hull fouling, transport vectors, establishing a network of advisors, etc. She feels the agency role should be to coordinate ongoing programs. DFG is not in outreach; outreach is not a strong component of their mandate. She felt the plan needed to use existing resources and not push them out of the management plan.
- Elaine Sledge, National Paint and Coatings Association: The association concurs with the plan findings on the threat of AIS. They support prevention vs. control and eradication. Coatings must have copper for anti-fouling. Inter-coastal vessels transport AIS. There are also non-ballast vectors. Non-biocide coatings are preferred. Written comments will provide additional information.
- Ron Eng, DFA: Action 211 proposes adding staff and hours at DFA Border Protection Stations with no indication of how this would be funded.
- Clint Meyer, Project Manager, Michael Brandman Associates: There is already a good regulatory program through CEQA. CEQA should be updated to address terrestrial and aquatic invasive species.

Public Meeting #2 (Oakland) Summary

The meeting was held August 30 in the Association of Bay Area Governments / Metropolitan Transportation Commission's conference room and had nearly 25 attendees. The following comments and questions were raised:

- Karl Malamud-Roam, Mosquito Ecologist, Contra Costa Mosquito VCD: He stated the regulatory aspects on control of public health were good. AIS present a huge problem. Insects and the diseases that come with them require continual surveillance and rapid response which the districts have in place. There is confusion in tone in the introduction; the plan treats non-native species and invasives as synonymous. The definition of invasives is not clear; the federal definition emphasizes harm (as stated in first paragraph) but the second paragraph treats all non-natives as invasive. It should not assume that non-native is detrimental; there are benefits of non-natives. The mosquito fish comments need correcting. There is a presumption that mosquito fish are known to harm; be careful of context of usage. They are a tool for resource management.
- Steve Hajik, Lake Co. Dept. of Agriculture: Spraying requires a permit from the regulatory water agency. County only allows licensed sprayers and inspects all applicators. His county passed an ordinance that lists banned weeds. He commented the plan should not forget agricultural commission offices.
- Caitlin Sweeney, SF Bay Conservation & Development Commission (BCDC): There is a critical omission of BCDC in the management plan. They have enforceable policies on fill, dredging, tidal marsh restoration projects and require eradication permits in their jurisdiction.
- Doug Johnson, California Invasive Plant Council: Plan needs to emphasize the impacts of chemical treatment as well as the impacts of all treatments. High level coordination

under Strategy 1A should include agricultural and environmental groups; should be strengthened to advocate for AIS council not partitioned as aquatic, but all inclusive.

- Cathy McGowan, Office of Research, UCOP: Lawrence Coleman, Vice Provost will submit detailed comments in writing. Cathy read from a 4-page document (attached) with preliminary comments. Solutions must be cross-cutting; researchers, policy makers and managers must work together. There must be formation of a California Center for Invasive Species; UC supports this strongly and wants it added to the plan. The plan needs to include members of UC and Sea Grant on the CAAIST (1A2). The section on Education and Outreach needs to include the UC Riverside Aquatic Center and Sea Grant Extension outreach. The education of ongoing researchers needs to be added. Section 7 provides an excellent start but needs to be expanded to include an academic research center.
- Mike Connor, Executive Director, San Francisco Estuary Institute (SFEI): SFEI has been working on biological invasions for over a decade. The rate of invasions is increasing; at present they are working on a multi-agency rapid response effort to eradicate invasive oysters in the South Bay. The report needs three things; 1) transparency; 2) peer review; and 3) competitive funding. First, transparency, the public cannot figure out who is working on what and therefore cannot determine overall success. Second, there is no call for outside peer review, which is necessary to insure that implementation is up to date. This is crucial for incorporation into the report. Third, there should be provision for competitive funding of line items in the document. Funding should go through a competitive process to insure transparency and the best quality work.
- Cathy Roybal, Contra Costa Dept. of Agriculture: Local county agricultural offices need to be involved.
- Karl Malamud-Roam, Mosquito Ecologist, Contra Costa Mosquito VCD: Department of Health Services needs to be added to agencies; the Health & Safety Code needs to be added to statutes. Use of vector should be carefully defined; conventional use includes mosquito control. The Society of Wetland Scientists was the first concerned with invasive cord grass. Strong kudos for rapid response.
- Arthur Berlowitz, U.S. Department of Agriculture (USDA): Goal is to prevent invasive species if we can. USDA reviews plants for the aquarium trade. He does not see how USDA can interface with the plan; it is not clear how USDA fits in. Thinks a center is a great idea. Document should show who has jurisdiction over what part of invasive species control.
- Sarah Mannell, Mill Valley, CA: She wants to know who does the public contact about invasive species. There are large carp in Corte Madera Creek; a protected creek; with steelhead fry in their guts.

Public Meeting #3 (Long Beach) Summary

The meeting was held at the Port of Long Beach Board Room on September 1 and had eight attendees. While no comments were presented, meeting attendees did raise the following questions:

1. How does the plan articulate agricultural invasive plants?
Answer: DFA is on the coordinating committee. The committee also worked with DPR.
2. For the Technical Advisory Committee, will there be one for the state, or will there be regional panels to focus on the issues for that region?
Answer: Having regional coordinating panels is a good suggestion and will be considered during finalization and/or implementation of the plan.

3. How much public outreach was there for these public meetings? He did not see a full press announcement.
Answer: There was targeted outreach to the OPC mailing list, stakeholder groups, web sites and DFG did a press release.
4. Is this a modification of an existing plan or a new plan?
Answer: It is restructured and rewritten from an earlier draft.
5. How is the SFEP associated with the project?
Answer: SFEP was contracted for one year by the SCC with funding from the Ocean Protection Council to finish the state AIS Plan.
6. Has there been outreach to shipping companies?
Answer: SLC, which is in charge of the ballast water program, has been keeping shipping up to speed. The ballast water recommendations were taken from the proposed actions. The plan basically looks at vectors other than shipping.

Prioritization Exercise Results

At all three meetings, posters were provided on the walls for attendees to indicate which action items (as described in the Draft AIS Plan) they believed should be “high” and “low” priority. After the close of the public comment period, meeting attendees held informal conversations with project staff and added to the posters. The posters were brought to each subsequent meeting to allow attendees to see which action items other individuals had prioritized.

One action was identified as extremely important: 8A3. Pursue the authority for DFG and DFA to establish a Rapid Response Program.

The following information was collected. Some of the action numbers changed as comments were addressed and the draft plan was finalized. The action numbers below were updated to reflect the new numbers; some of the original actions were deleted or moved in the editing process. Some of the action language has been edited since this summary was made. A few actions are listed as both high and low priorities because of differing opinions among participants. For final priorities identified see Chapter 8.

Objective 1: Coordination & Collaboration

High Priority Actions

- 1A1. Develop an executive level consultation process.
- 1A2. Form the California Agencies AIS Team (CAAIST).
- 1A7. Identify lead state agencies for particular AIS, water bodies and invasion vectors.
- 1A8. Identify agency personnel required for AIS management.
- 1A9. Improve state websites related to AIS.
- 1A10. Assess effectiveness of and gaps in AIS programs.
- 1B4. Expand participation in local AIS efforts and task forces.
- 1B5. Expand participation in regional, national and international AIS task forces.
- 1B7. Participate in national and international conferences.
- 1C2. Establish stable, long-term funding to help implement this plan.
- 1C3. Provide state funding for the AIS positions.
- 1C4. Provide state funding for a rapid response program.
- 1C5. Hire a funding development specialist.
- 1C6. Provide new funding mechanisms.

Low Priority Actions

All remaining actions for this objective not shown as high priority above.

Objective 2: Prevention

High Priority Actions

- 2B1. Quantify the ballast water and hull fouling vectors and assess invasion risk.
- 2B2. Continue and improve state ballast water inspection and enforcement program.
- 2B3. Implement discharge standards for treated ballast water.
- 2B4. Identify and address gaps in the Marine Invasive Species Program.
- 2B7. Quantify and assess the role of commercial fishing vessels as AIS vector.
- 2C1. Quantify and assess the role of recreational boating as an AIS vector.
- 2C2. Develop a recreational boating outreach and management program.
- 2C3. Develop a watercraft inspection program for high priority boat launch sites.
- 2C4. Quantify and assess the role of recreational fishing as an AIS vector.
- 2C5. Develop a recreational fishing outreach and management program.
- 2C6. Develop guidelines for: disposal of invasive species, cleaning of gear disposal of live bait.
- 2D1. Quantify and assess live bait as an AIS vector.
- 2E1. Quantify and assess fisheries enhancement as an AIS vector.
- 2I1. Increase staffing and hours of operation at DFA Border Protection Stations.
- 2I2. Develop guidelines for border inspections.
- 2I3. Increase DFG enforcement of current regulations on prohibited and restricted species.
- 2I4. Ensure adequate staffing and cargo inspection guidelines at ports and airports.
- 2I5. Continue disease sampling for shipments and stocks of live aquatic species.
- 2I6. Identify mail order, online vendors selling CA prohibited and restricted species.

Low Priority Actions

- 2B3. Implement discharge standards for treated ballast water.
- 2B4. Identify and address gaps in the Marine Invasive Species Program.
- 2C All actions mandating hull cleaning and/or inspections.
- 2C10 Link activities to the national Stop Aquatic Hitchhikers campaign. (Action later deleted).
- 2E4. Weigh benefits of mosquito-fish introductions.

Objective 3: Early Detection & Monitoring

High Priority Actions

- 3A1. Assess current monitoring of the state waters for early detection opportunities.
- 3A3. Develop statewide approach to early detection.
- 3A4. Outreach to those regularly sampling state waters.
- 3A5. Create and train a statewide citizen monitoring network.
- 3B1. Assess long-term AIS monitoring of state waters.
- 3B3. Monitor locations with high invasion rates.
- 3B7. Review the efficacy of long-term monitoring systems.

Low Priority Actions

- 3B6. Include maps of existing AIS in California waters in DFG BIOS system.

Objective 4: Rapid Response & Eradication

High Priority Actions

- 4A1. Develop and implement a statewide rapid response plan.
- 4A2. Evaluate and coordinate existing systems for reporting AIS sightings.
- 4A3. Clarify among the agencies and organizations involved who is responsible for which areas and/or species. (This action from August '06 draft has been deleted. It will be addressed through current actions 4A1 and 4A3).
- 4A4. Explore permanent funding to implement rapid response.
- 4B1. Review effectiveness of eradication programs.

- 4B2. Continue and complete current eradication efforts.
- 4B3. Standardize criteria for identifying priority species for eradication.
- 4B4. Develop a method to prioritize sites of AIS invasion concern.

Low Priority Actions

All remaining actions for this objective not shown as high priority above.

Objective 5: Long-Term Control & Management

High Priority Actions

- 5B All strategy action items; limit the dispersal of established AIS to new water bodies.
- 5C2. Coordinate entities to meet AIS protection and restoration objectives.
- 5C6. Assess guidelines for preventing AIS spread in habitat restoration and shoreline landscaping projects. (See 6C5)

Low Priority Actions

- 5B1. Establish boat washing stations and disposal facilities at infested water bodies.
- 5B3. Use volunteer monitors to conduct AIS inspections.

Objective 6: Education & Outreach

High Priority Actions

- 6A1. Inventory education and outreach efforts. Develop a state AIS communication strategy.
- 6A2. Partner with ongoing outreach campaigns.
- 6A4. Develop posters, brochures and articles for industry sectors and user groups.
- 6A5. Develop permanent interpretive displays at marinas, boat ramps, and fishing sites.
- 6A6. Work directly with industry trade shows to deliver the AIS message.
- 6A7. Present AIS information at public gatherings.
- 6A8. Include AIS information in state hunting, fishing and boating regulations and licenses.
- 6A9. Include AIS information in fishing and recreational publications.
- 6A10. Develop and distribute AIS identification cards
- 6A11. Encourage industries to offer noninvasive alternatives to AIS.
- 6A12. Partner with stakeholders and interest groups to broaden education efforts.
- 6A13. Educate waterfront and shoreline property owners about AIS.
- 6A14. Develop and offer AIS management classes for professional organizations.
- 6A15. Continue state education measures concerning ballast water.
- 6C2. Educate researchers on AIS containment, disposal methods and legal restrictions.
- 6C5. Disseminate guidelines to promote the use of native plants. (See 5C6)

Objective 7: Research

High Priority Actions

Note: suggestion was made to add “increase coordination of researchers and develop research agenda based on high priority research needs.”

- 7A1. Host workshops to develop AIS research priorities and identify gaps.
- 7A2. Assess, continue and complete current studies.
- 7A3. Develop a strategy to communicate and support research needs.
- 7C4. Identify opportunities for interagency funding of AIS management research.

Low Priority Actions

- 7C3. Consider test center to evaluate ballast water treatment technologies.

Objective 8: Policy

High Priority Actions

- 8A1. Establish a regulatory review committee.
- 8A2. Identify the potential for improved regulatory coordination.
- 8A3. Pursue the authority to establish an interagency rapid response program.
- 8A4. Explore the need for additional state authority for AIS management.
- 8A6. Review current system for regulating plant and animal importations. .

Low Priority Actions

None indicated

2006 California Invasive Species Management Plan Public Meeting Participants

Name	Affiliation	Email	*Mtg.
Alejandrino, Emily	Central Valley Water Board	ealejandrino@waterboards.ca.gov	Sac
Anderson, Tim P.	Friends of Seal Beach NNR	Tim@birdingbyboat.org	LB
Berge, John	PMSA	jberge@pmsaship.com	Sac
Berlowitz, Arthur	USDA/APHIS/PPQ	Arthur.berlowitz@aphis.usda.gov	Oak
Bohan, Drew	OPC	drew.bohan@resources.ca.gov	Sac
Breninger, Dave	Placer Co. Water Agency Recreational Boaters of CA	dbreninger@pcwa.net	Sac
Brockbank, Marcia	SFEP	mbrockbank@waterboards.ca.gov	Oak
Brusati, Elizabeth	Cal-IPC	edbrusati@cal-ipc.org	Oak
Carlock, Marcia	DBW	mcarlock@dbw.ca.gov	Sac
Cassell, Jodi	California Sea Grant	jlcassell@ucdavis.edu	Sac
Clamurro, Lori	Delta Protection Commission	loridpc@citlink.net	Sac
Coleman, Lawrence	University of California	Lawrence.coleman@ucop.edu	Oak
Connor, Mike	SFEI	mikecc@sfei.org	Oak
Doherty, Abe	Coastal Conservancy	adoherty@scc.ca.gov	Sac Oak
Drill, Sabrina	UCCE	sldrill@ucdavis.edu	LB
El, Terri	DBW	tely@dbw.ca.gov	Sac
Ellis, Susan	DFG	sellis@dfg.ca.gov	Sac Oak LB
Eng, Ron	CDFA	reng@cdfa.ca.gov	Sac
Falkner, Maurya	CA State Lands Commission	falknem@slc.ca.gov	Sac
Fernandez, Linda	UC Berkeley – Dept. of Ag. & Resource Econ.	Linda.fernandez@ucb.edu	Oak
Fredrickson, Justin	Cal. Farm Bureau Federation	jfredrickson@cfbf.com	Sac
Fujioka, Kenn	Mosquito & Vector Control Assn. of Ca/San Gabriel Valley MVCD	kfujioka@sgvmosquito.org	LB
Gouvaia, John	Alameda Co. Dept. of Agric.	John.gouvaia@algov.org	Oak
Grosberg, Rick	UC Davis	rkgrosberg@ucdavis.edu	Sac
Grosholz, Ted	UC Davis	tedgrosholz@ucdavis.edu	Sac
Gurish, Jon	Coastal Conservancy	jpgurish@scc.ca.gov	Oak
Hakjick, Steve	Lake Co. Ag. Dept.	Steveh@co.lake.ca.us	Oak
Hanson, Joel	SMBRC/F	jhanson@waterboards.ca.gov	LB
Horenstein, Julie	DFG	jhorenstein@dfg.ca.gov	Sac Oak LB
Jirik, Andrew	Port of Los Angeles	ajirik@portla.org	LB
Johnson, Doug	Cal-IPC	dwjohnson@cal-ipc.org	Oak
Karkanen, Kristie	Hanson Env./SWC	kkarkanen@hansonenv.com	Oak
Kolipinski, Dr. Mietek	National Park Service	Mietek-kolipinski@nps.gov	Oak
Liu, Marie	Senate Nat. Resources	Marie.liu@sen.ca.gov	Sac
Liu, Qingin	DFG	qliu@dfg.ca.gov	Sac
Long, Dennis	MBSF	info@mbnmsf.org	Oak
Lynch, Michelle	SWRCB Clean Water Team	smlynch@waterboards.ca.gov	LB
Malamud-Roam, Karl	CCMVCD, AMCA	kmr@ccmvcd.net	Oak
Mannell, S.		sgarmanii@sbc.global.net	Oak

*Mtg. = meeting locations

Sac – Sacramento, August 28, 2006

Oak – Oakland, August 30, 2006

LB – Long Beach – September 1, 2006

2006 California Invasive Species Management Plan Public Meeting Participants

Name	Affiliation	Email	*Mtg.
McDowell, Karen	SFEP	kmcdowell@waterboards.ca.gov	Sac Oak LB
McLain, Susan	Stockton Sailing Club	manager@stocktonsc.org	Sac
Meyer, Clint	Michael Brandman Associates	cmeyer@brandman.com	Sac
Milton, Joe	Dept. of Fish & Game	jmilton@dfg.ca.gov	Sac
Magowan, Cathie	UC Office of the President	Cathie.magowan@ucop.edu	Oak
Noda, Gwen	UCLA	gwennoda@ucla.edu	LB
Noto, Dante	UC Office of the President	Dante.noto@ucop.edu	Oak
Rosales, Ava	CH2M Hill	Ava.rosales@ch2m.com	Oak
Roybal, Cathy	Contra Costa Dept. of Ag	croybal@ag.cccounty.us	Oak
Schnabel, Duane L.	CDFA	dschnabel@cdfa.ca.gov	Sac
Schon, Woody	Sac/Yolo Mosquito & Vector Control	wschon@fightthebite.net	Sac
Simpson, F.		fsimpson@rmc.ca.gov	LB
Sledge, Elaine	On behalf of Nat'l Paint & Coatings Assoc.		Sac
Smith, Larry	USACE		LB
Snyder, Barry	AMEC	Barry.snyder@amec.com	LB
Stephens, David	CA State Lands Commission		Oak
Stransky, Chris	Nautilus	chris@nautilusenvironmental.com	LB
Swanson, Lisa	Matson Navigation	lswanson@matson.com	Oak
Swauger, Troy	DFG	tswauger@dfg.ca.gov	Sac Oak
Sweeney, Caitlin	BCDC	caitlins@bcdc.ca.gov	Oak
Tamanaha, Miwa	SMBRC	mtamanaha@waterboards.ca.gov	LB
Tandoc, Tom	DOI OEPC	Tom.tandoc@gmail.com	Oak
Topel, Jack	SMBRC	jtopel@waterboards.ca.gov	LB
Torbett, Tim	USDA, APHIS	Timothy.J.Torbett@aphis.usda.gov	Oak
Tsuneyoshi, Roy	DBW	rtsuneyoshi@dbwq.ca.gov	Sac
Varghis, Jacob	USCG	Jacob.varghis@uscg.mil	LB
Veloz, MK	Northern California Marine Association	Ncma-gr@comcast.net	Oak
Verity, Rebecca	UC Office of the President	Rebecca.verity@ucop.edu	Sac
Vignolo, John	SJC Mosquito and Vector Control District		Sac
Young, Sara	USCG	Sara.e.young@uscg.mil	Oak

*Mtg. = meeting locations

Sac – Sacramento, August 28, 2006

Oak – Oakland, August 30, 2006

LB – Long Beach – September 1, 2006

2004 Draft Plan Process

The first draft of the AIS management plan included the valuable input of many dedicated individuals with expertise on a wide variety of topics relating to AIS in California and the region. Contributors ranged from local, state and federal agencies, to industry representatives, NGOs and other stakeholders.

Funding for the development of the first draft was provided by the DFG and USFWS. Susan Ellis, the Statewide Invasive Species Coordinator, developed a contract with the University of California, Davis, to develop an Aquatic Invasive Species Plan following the general outline provided by the Aquatic Nuisance Species Task Force. Ted Grosholz was the Principal Investigator for the contract. The deliverables for the contract included facilitated meetings to ensure that agency and stakeholder input was incorporated in the Plan.

In August of 2002, representatives of 14 agencies with a role in managing aquatic invasive species came together to participate in a State AIS Planning Workshop in Davis, CA. Results of that meeting included a draft set of goals and objectives for an AIS Plan and a brief summary of current AIS activities for some of the participating agencies. There was agreement that a state plan could help identify AIS of concern, and provide a framework for how to address AIS prevention, eradication, research, management and education and outreach in a more coordinated and comprehensive fashion.

Additional information for the plan was gathered from other state and federal plans, various websites, published papers, internal agency documents and through personal communication (phone and email).

The Plan's Review Committee (members listed below) commented on a first draft of the plan, which was then distributed to a broader group of Agency reviewers and for public review.

Review Committee for the 2004 Draft Plan

Lars Anderson, United States Department of Agriculture, Agricultural Research Service
Robert Leavitt, California Department of Food and Agriculture
Dale Steele, California Department of Fish and Game
Mark Sytsma, Portland State University
Erin Williams, United States Fish and Wildlife Service

Participation by Other Agencies and Groups

Courtney Albrecht, California Department of Food and Agriculture
Marcia Carlock, California Department of Boating and Waterways
Marina Carzola, California Coastal Commission
Jason Churchill, Lahontan Regional Water Quality Control Board
Nate Dechoretz, California Department of Food and Agriculture
Joseph DiTomaso, University of California, Davis
Maurya Falkner, California State Lands Commission
Connie Ford, State Water Resources Control Board
Joann Furse, California Sea Grant
Eric Gillies, California State Lands Commission
Bob Hoffman, National Marine Fisheries Service
Christina Johnson, California Sea Grant
Jaime Kooser, California Coastal Commission
Steve Lonhart, Monterey Bay National Marine Sanctuary
Karen McDowell, California Sea Grant
Cindy Messer, California Department of Water Resources
Julie Owen, California Department of Boating and Waterways
Bill Paznokas, California Department of Fish and Game
Stephen Phillips, Pacific States Marine Fisheries Commission
Carolyn Pizzo, U.S. Department of Agriculture

Jim Rains, California Department of Food and Agriculture
Steve Schoenig, California Department of Food and Agriculture
Jody Sears, California Department of Water Resources
Linda Sheehan, Pacific Regional Office, The Ocean Conservancy
Basia Trout, Bureau of Reclamation
Tanya Veldhuizen, California Department of Water Resources
Kim Webb, United States Fish and Wildlife Service
Katherine Zarembo, Invasive Spartina Project

2002-2003 Stakeholder Meeting Comments

Incorporating recommendations from a broad array of stakeholders contributes to a better and more responsive AIS plan for the State of California. In an effort to get input on concerns and perspectives regarding AIS during the plan's development, scoping meetings were held to get input from many organizations, businesses, industry representatives and individuals. A northern California stakeholder meeting was held in Sacramento on November 19, 2002. A southern California stakeholder meeting was held on March 20, 2003. Participants provided valuable comments, most of which have been incorporated into the management plan.

Northern California Stakeholder Comments

Invitations were sent to over 200 individuals and included representatives of many industries including the pet, aquarium, and nursery/landscaping trades, live bait and seafood dealers, and ports and marinas. The following individuals attended:

Drew Alden, Growers in Tomales Bay
John Berg, Pacific Merchant Shipping Association
Thomas Confal, IPM Specialist, Bitterroot Restoration, Inc.
John Cruger-Hansen, Harbor Master, City of Antioch
Daniel Garcia, Public Affairs, Marine Aquarists Roundtable of Sacramento
Jeff Hart, President, Habitat Assessment and Restoration Team, Inc.
James Kidder, President, Colombo Bait, Inc.
Karen McDowell, Project Coordinator, West Coast Ballast Outreach Project
James Mills, Vice President and Regional Manager, Westree Marinas
Fleur O'Neill, Policy Education Coordinator, Save Our Shores
John O'Sullivan, Curator of Field Operations, Monterey Bay Aquarium
Roger Phillips, Applied Research Manager, Monterey Bay Aquarium
Kirsten Upson, The Nature Conservancy
M.K. Veloz, Administrative Director, Northern California Marine Association

Mike Fraidenburg of Dynamic Solutions Group of Olympia, Washington facilitated the meeting. Susan Ellis (State Invasive Species Coordinator) explained the different roles and responsibilities of state agencies and current management activities for aquatic invasive species in California. Ted Grosholz (UCD) and Holly Crosson (UCD) discussed the process for the plan's development including future stakeholder and agency meetings as well as the current status of the plan. Mark Sytsma (Portland State University, Portland, Oregon) discussed Oregon's experience with writing a state management plan for aquatic invasive species as well as the uses and limits of state plans. The rest of the meeting was spent listening to concerns and suggestions presented by the stakeholders. Most of the comments could be divided into the categories of Education, Prevention, Best Management Practices, Regulation, State Invasive Species Council and General AIS Management Plan development suggestions.

EDUCATION

- Education about AIS should be a top priority.
- Educational tools should be used instead of legislation and regulations.
- A list of AIS experts should be made available to stakeholders.

- AIS information should be available at all bait shops, marinas, boat access areas, etc.
- It may take 20 years, but *all* of the public needs to be educated about AIS (example used was educational programs for dealing with issues such as recycling, littering, etc.).
- The public needs to know why they should care about AIS (i.e., the consequences of invasions).
- The public as well as industry needs to know the economic cost of AIS (cost/benefit analysis).
- Stakeholders are a resource and can help with education, such as public service announcements.
- Multiply educational efforts by identifying what industry sectors can do to help with AIS education and outreach (i.e., using Wal-Mart, Home Depot, PetSmart etc. to educate their customers about AIS).
- A database is needed that focuses on providing information about AIS outreach, education and research-based grants. Information on who is doing what on AIS should also be available and include efforts by NGO's, universities and industry.
- AIS hazards that exist in particular areas need to be identified and publicized before they spread.
- Cross-education between interest groups and government would help understanding of the issues and concerns for both groups.
- Education in the K-12 classroom is important; biologists should go into schools to talk about AIS.
- Aqua-culturists need current information to help avoid AIS introduction problems of the past.
- There should be guidelines developed to help groups "self-police" and educate their constituents.
- Coordination needs to be improved between state, regional and federal groups.
- Identify all educational and technical resources currently available and make them easily accessible.
- Identify where the information gaps are.

PREVENTION (including Early Detection and Rapid Response)

- A Rapid Response program requires extensive coordination but is critical.
- An AIS "hotline" is needed so new sightings can be reported immediately.
- Management of introduction pathways is important for AIS prevention.
- We should have the ethic of not transporting California's AIS elsewhere; include this in the plan.
- The largest percentage of funds should be spent on prevention since it is the most cost-effective.
- Early detection is key to successful AIS eradication and management.
- Each vector/pathway that is identified in the plan should have a lead agency listed as well as a stakeholder group.
- Look into whether funds from anti-terrorism sources could be tapped into (i.e. to address the intentional introduction of a devastating foreign, water-borne organism).

BEST MANAGEMENT PRACTICES (BMPs)

- Each industry should be actively involved in the development of the BMPs that relate to them.
- BMPs can be a tool for industry to understand and meet their obligations.
- Consider using a neutral third party or group (scientific panel) to offer advice and develop recommendations for BMPs instead of leaving development to agencies or industry alone.
- Investigate how "management" of a landscape (or lack thereof) affects the likelihood of invasion.

REGULATION

- The public and industry need to have an understanding of AIS laws and their history before they go into effect.
- We need more education and outreach on laws already passed so the public can abide by them.
- AIS laws and penalties need to be publicized in the DFG regulations right up front.
- Regulatory agencies need to "get on the same page"; inconsistencies confuse the public.
- There should be more opportunity for stakeholder input when new regulations are being written, especially when livelihoods are at stake (*Caulerpa* in southern California was example used).
- A patchwork of regulations makes coordination between state, regional and federal levels difficult.

- Inter-jurisdictional coordination needs improvement to make compliance easier.
- Guidelines need to be developed for meeting NPDES permit requirements.
- A process needs to be developed to authorize within-state transfer of approved live aquatic species.
- Laws, regulations and permits need to be more clear, consistent and effective.
- Enforcement needs to be more vigilant and consistent.
- Stakeholder input should be solicited when permitting procedures are being written.
- New legislation should be written with the help of stakeholders (ballast water example was used).
- Methods for complying with aquaculture regulations need to be clearer.
- Some stakeholders feel like they are working in a vacuum; they need guidelines to help them determine if the right thing is being done.
- Develop a mechanism for mandatory reporting of listed AIS.
- Make sure regulations that affect industry are feasible (shipping example was used).
- Use existing Department of Boating and Waterways (DBW) laws to make AIS introductions illegal.
- Create a single, central clearing house for information on all AIS laws and regulations.

STATE AQUATIC INVASIVE SPECIES COUNCIL (ISC)

- The ISC needs to have broader public representation; consider expanding it to include more stakeholder groups.
- Each industry should decide who will represent them on the ISC.
- The number of industry representatives should be equal to or higher than the number of government representatives on the ISC.
- DBW should not represent all boating interests on the ISC.

GENERAL AIS MANAGEMENT PLAN DEVELOPMENT

- Make the plan short and simple.
- Funding priorities in the plan should be delineated by the ISC or another representative group.
- Work together; don't have government on one side and resource users on the other.
- Stakeholders are interested in practical solutions.
- Use common names in addition to scientific names for AIS to make the plan more user-friendly.
- Limit use of acronyms or fully explain them.
- Prioritization of species within the plan is necessary.
- Develop a system to prioritize aquatic invasive species using the ISC or another representative group.
- Use assigned "Management Classes" as Oregon did rather than prioritizing species.
- Consider using DFA's ABC List of Noxious Weeds as a model.
- Develop a process to determine which method gets used to control or eradicate a species.
- Limit administrative overhead.
- Develop a process to resolve disputes.
- Make sure all groups are represented (include tribes, irrigation districts, bass anglers, boaters, etc.).
- The planning effort should take into account the target species as well as the environment.
- There is a concern that some may try to sidetrack the plan or use the plan to push their own agenda.
- Consider using AIS instead of ANS (the word "invasive" is perhaps better than "nuisance").
- Write into the plan that state and federal agencies coordinate through formal written agreements.
- High profile species should not take over concern for lesser-known problem species.
- Support for current AIS programs should be continued.
- Make sure limited resources go to on-the ground projects rather than getting lost in the bureaucracy.

Southern California Stakeholder Comments

Invitations were sent to over 450 individuals and included representatives of local water agencies and irrigation districts, tribes, various industries including the pet, aquarium, aquaculture and nursery/landscaping trades, live bait and seafood dealers, ports, marinas and shippers, and others with an interest in aquatic invasive species. The following individuals attended:

Douglas Ball, Los Angeles Department of Water and Power
Mark Baumann, Live Cargo Reptile and Fish/ San Diego Fish Society
Paul Brown, Project Analyst, Port of San Diego
Thomas Buckowski, Lake Biologist, Lake Mission Viejo Association
Larry Chapp, Vice President, Divisional Merchandise Manager, PETCO
Hugh Cobb, Pacific Coast Bait and Tackle
Tom Gass, Manager, El Pescado Caliente
Chris Graham, Lake Biologist, Lake Mission Viejo Association
Miguel Hernandez, Watermaster, Natural Resources Office, Pauma Band of Mission Indians
Annaliese Hettinger, The Diving Locker
Steve Lonhart, Monterey Bay National Marine Sanctuary
Marshall Meyers, Executive Vice President, Pet Industry Joint Advisory Council
Craig Parsons, Live Fish, Reptile, Bird and Small Animal Buyer, PETCO
Russell Moll, Director, California Sea Grant/ Scripps Institute of Oceanography (SIO)
Anandra Ranasinghe, Southern California Coastal Water Research Project
Freda Reid, San Dieguito Lagoon Committee and Research Associate (SIO)
Andi Shluker, The Nature Conservancy of Hawaii
Ed Smith, General Manager, Palo Verde Irrigation District

Mike Fraidenburg of Dynamic Solutions Group (DSG) of Olympia, Washington facilitated the meeting. Ted Grosholz (UCD) discussed the ecological and economic costs of aquatic invasive species and introduced the goals and purpose of the meeting. Susan Ellis (State Invasive Species Coordinator) explained the different roles and responsibilities of state agencies and current management activities for aquatic invasive species in California, and provided an update on the formation of the California Aquatic Invasive Species Council. Mark Sytsma (Portland State University, Portland, Oregon) discussed Oregon's experience with writing a state management plan for aquatic invasive species as well as the uses and limits of state plans. Holly Crosson (UCD) discussed the process for the California plan's development and progress on the plan thus far. The rest of the meeting was spent discussing concerns and suggestions presented by the stakeholders. Most of the comments could be divided into the categories of Education, Prevention, Best Management Practices, Regulation and General AIS Management Plan development. Below is a summary of specific comments made under each of these categories.

EDUCATION

- A comprehensive strategy for AIS Education and Outreach should be developed.
- Education should be used instead of new legislation and regulation.
- More AIS information needs to reach the public, retail stores, industry, schools, etc.
- Prioritize educational efforts based on risk associated with a given pathway.
- Piggyback onto current Agency educational programs.
- Consider "green labeling" to help consumers make the right choice; peer pressure will encourage appropriate behavior/decisions of others.
- Educational efforts need to take into account the multi-cultural nature of CA (signs, etc. need to be published in other appropriate languages besides English).
- Marketing experts should be used to get a single, common AIS message out across the region.
- The AIS message has to touch people personally (an impact on the quality of life or the pocketbook).
- Educational materials should be tailored to specific industry sectors (aquaculture, boaters, bait shops, pet/aquarium retailers, etc.).

- The public as well as industry needs to know the economic cost of AIS (pay now or pay more later).
- Stakeholders are a resource and can help with educational efforts (i.e., using Recreational Fisherman's Alliance, American Sportfishing Association, Diving or Tropical Fish Clubs, etc.).
- Multiply educational efforts by identifying what industry sectors can do to help with AIS education and outreach; partner with pet/aquarium and other industries.
- Develop better ways to get the AIS message out, for instance, don't just have a booth at trade shows but work directly with promoters of shows (example – Fred Hall Show).
- Publish articles in Western Outdoor News and similar magazines.
- Train people to use the AIS "Traveling Trunk" and have them take it "on the road".
- A comprehensive AIS species list should be developed and publicized with appropriate contacts listed for experts associated with each species.
- There should be guidelines developed to help groups "self-regulate" and educate their constituents.

PREVENTION (including Early Detection and Rapid Response)

- An AIS Prevention Program is key to success but is not foolproof.
- AIS Screening and Risk Assessment Programs should not be overly simplistic or arbitrary. They need to be based on the best available information and sound science.
- Volunteers can be an important piece in monitoring efforts for early detection of AIS.
- Training volunteers takes a lot of organization and keeping them motivated over the long term can be challenging
- Interaction with Watershed Councils is important.
- An AIS "hotline" is needed so new sightings can be reported immediately.
- Determine the economic consequences of pathway prevention.
- Look into funds available through "homeland security".

BEST MANAGEMENT PRACTICES (BMPs)

- Develop guidelines for acceptable, humane and environmentally safe ways to deal with unwanted aquatic organisms (whether it be proper disposal, returning the organism to the retailer, or being “adopted” by someone else).
- Industry and individuals need to accept a degree of economic liability and responsibility for their actions regarding AIS introduction and spread.
- Create industry standards to regulate and penalize the bad actors.
- Each industry should be actively involved in the development of their own BMP’s. Weak industry initiative yields weak BMPs.
- Industry documentation is needed to support accountability.
- Determine if BMPs should be regulatory.
- Develop BMPs for Bass Tournaments.
- BMPs need to maintain some flexibility and an acknowledgement that “one size does not fit all”.
- BMPs can help achieve buy-in, create institutional memory, give an outsider a way to monitor activities and are already an accepted process in industry (similar to ISO example).

REGULATION

- Enforce the laws and regulations we already have, rather than pass new ones.
- Provide positive incentives to encourage self-regulation.
- Provide better information about what AIS laws are currently in place and how to comply with them.
- A few bad apples are causing regulatory problems for all involved.
- Determine more effective ways to catch violators of current laws, including interstate transport.
- Improve current regulations. Piranhas and snakeheads were used as examples of species that are regulated but still are imported and released. We should learn from these experiences and attempt to prevent similar situations.

GENERAL AIS MANAGEMENT PLAN DEVELOPMENT

- Coordinate with the National Marine Sanctuaries on Plan development.
- Work with California Sea Grant to achieve success in plan implementation, especially with education and outreach strategies and actions.
- Be creative with funding and partnerships.
- Leverage resources by doubling up on surveys, inspections, etc. that are already being done.
- Continually evaluate and update the plan and make sure the plan’s goals are being realized (develop a scorecard).
- Make sure the functioning of the California Aquatic Invasive Species Council is evaluated so it does not outlive its useful purpose. If changes are needed to make the council more effective, they should be able to be promoted through other agencies and the general public.
- Take steps to minimize the loss of dollars through overhead.
- Do not set the stage for failure by creating a timeline that cannot be met.
- Involve economists if possible (can a dollar figure be put on habitat/resources?).
- Make it clear who will determine priorities in the plan and what gets funded.
- Incorporate Watershed Councils in the planning effort.
- Make the relationship between the plan and AIS policy clear.
- Determine how plan implementers will interact with on-the-ground managers.
- Write the plan so that it facilitates funding for implementation. The plan should be user-friendly.
- Plans should promote accountability so that managers have an incentive to perform and meet commitments.

APPENDIX F: EXECUTIVE SUMMARY OF *BIOLOGICAL INVASIONS:* *RECOMMENDATIONS FOR U.S. POLICY AND MANAGEMENT*

Position Paper of the Ecological Society of America

Biological Invasions: Recommendations for U.S. Policy and Management

David M. Lodge, Susan L. Williams, Hugh MacIsaac, Keith Hayes, Brian Leung, Sarah Reichard, Richard N. Mack, Peter B. Moyle, Maggie Smith, David A. Andow, James T. Carlton and Anthony McMichael, 2006

Executive Summary

The spread of nonindigenous (non-native) species introduced into the United States is a significant and growing national problem, costing taxpayers hundreds of billions of dollars in environmental degradation, lost agricultural productivity, increased health problems and expensive prevention and eradication efforts. Some nonindigenous species are introduced intentionally and are highly valued by humans, e.g., agriculture, aquaculture, and ornamental species. Many other species are introduced as by-products of human activity, especially through the increasing global transportation of humans and commercial goods. A subset of introduced species spread widely, become abundant and cause harm. The definition of “harm” is a function of human values, which often differ in different regions and may change temporally. Nevertheless, harm is often unambiguous and the species from elsewhere that causes harm are referred to as invasive nonindigenous species. They are the focus of policy and management concern because of their serious and complex contributions to diseases of plants, animals and humans; reductions in native species; changes in ecosystem function; and financial losses.

Well known examples of invasive nonindigenous species include the vine kudzu (*Pueraria lobata*) in the southeastern U.S., cheat grass (*Bromus tectorum*) in the western U.S., and zebra mussel (*Dreissena polymorpha*) in the central U.S. More recent arrivals with large net negative impacts on the environment, agriculture, forestry, industry and human health include West Nile virus, the seaweed *Caulerpa* (*Caulerpa taxifolia*), Asian long-horn beetle (*Anoplophora glabripennis*), emerald ash borer beetle (*Agilus planipennis*), sudden oak death (*Phytophthora ramorum*), monkeypox virus, and the SARS virus. Without management, the populations of these species grow and spread such that damages accelerate over time. In contrast to many other forms of pollution, such widespread invasions become irreversible because the technology often does not exist to selectively eradicate species. Relative to the economic and ecological costs of other forms of environmental pollution, the costs of nonindigenous species are therefore of particular concern because they are likely to be borne over very long time frames.

Despite the great diversity of invasive species and their impacts, an identified group of pathways transport species, and a common set of biological processes – introduction, establishment, spread, and impact – operate in all invasions. Policy and management solutions become clearer when these common pathways and processes are recognized. Nevertheless the possible management responses diminish as any invasion progresses. Prevention is possible only before a species arrives or at the point of entry. Thereafter, a narrow window of opportunity for eradication exists before some species spread so widely that it is impossible or infeasible to locate and kill all populations. Once a species is too widespread for eradication, only three management options remain: controlling populations in selected locations; active mitigation of impacts; or simply bearing the cost of the changes caused by the invader. U.S. policy, often by default, has largely adopted the last option, i.e., acceptance of often irreversible environmental and economic damage.

The only study to attempt a nationwide estimate of the economic costs to the U.S. of nonindigenous species concluded that annual costs exceed \$120 billion (Pimentel et al. 2005), which

we regard as an underestimate because the majority of invasive species were not included in the study. Even this underestimate equates to costs of \$1,100 per U.S. household per year, costs that will continue to grow unless prevention and management of invasive species improves. Yet, the U.S. has allowed invasions to continue and damages to increase.

A more cost-effective approach would include greater investments in prevention and other active management steps, including early detection, eradication and control. Recent scientific advances in our understanding of biological invasions make it clear that more effective options exist for these threats. Here, on behalf of the Ecological Society of America, we make six recommendations for government action that, if implemented, would substantially reduce the current and future damages to the U.S. from invasive species. We include proposals for cost-effective government actions that will address these problems with the understanding that other measures are important to complement governmental responses. Key challenges that require urgent government action include prevention, detection, eradication and control of harmful non-native species, and the coordination of these efforts at the state, federal and international levels. Table 1 summarizes the major recommendations, data and techniques for implementation, and proposed lead organizations.

Prevention

Recommendation 1. Use a combination of existing and new technologies, education strategies, industry codes of conduct, and government oversight to prevent introductions from pathways that already are well known to be major sources of nonindigenous species, and to monitor other pathways into the United States to better assess the degree of risk they pose.

Recommendation 2. Screen live organisms proposed for importation into the U.S. for environmental, economic and human health risk before a decision is made to allow entry. Risk analysis tools should be repeatable, transparent, supported by current scientific findings and applied to all pathways, across all agency jurisdictions.

Early Detection, Eradication and Control

Recommendation 3. Use new technology to improve active surveillance of invasive species to increase the success of rapid response and eradication efforts, in cooperation with existing web-based information networks in universities, herbaria, museums and state agencies.

Recommendation 4. Make legal authority and emergency funding available for eradication and control to proceed rapidly once a newly established potentially invasive species is detected. Current legal mechanisms and funding for responses to agricultural pests and parasites, and to human pathogens, should be extended to all potentially invasive species in all habitats, and employed commensurate with the threat.

Recommendation 5. Provide on-going funding and incentives for slowing the spread of established invasive species on public and private lands, in cooperation with the states and tribal governing bodies.

Establishing a National Center for Invasive Species Management

Recommendation 6. Expand existing authority of the National Invasive Species Council (NISC), including the establishment of a National Center for Invasive Species Management under NISC, to better coordinate policies among government agencies and with other countries. Current U.S. examples of intergovernmental cooperation include the National Interagency Fire Center and the Center for Disease Control and Prevention. Unless these or conceptually similar recommendations are adopted, the rate of damages to our environment, economy and health caused by invasive species will accelerate. These damages are spread across many stakeholders, and no strong, nationwide group has emerged to encourage industries that are pathways of introduction to reduce the threat. Hence the federal government must assume greater leadership to coordinate efforts by all

levels of government. We recognize that the problem is complex and interdisciplinary, includes many pathways, a tremendous diversity of organisms that are invasive, and the vulnerability of all terrestrial, marine and freshwater ecosystems. Despite this complexity, and the consequent overlapping and sometimes conflicting state, federal and international policies involved, the six recommendations described in this paper provide sound guidance for the future. Recent scientific and interdisciplinary advances provide a strong basis for rapid implementation of these cost-effective solutions.

APPENDIX G: LIST OF REGULATED SPECIES IN CALIFORNIA

Aquatic invasive species are regulated by a number of state and federal regulations. The aquatic plant and animal species restricted in California, and the regulations that apply to each, are listed below.

ANIMALS

In California, the animal species considered detrimental to native wildlife, state agriculture or public health and safety are listed in California Administrative Code Title 14, Section 671. Importation, transportation and possession of the restricted animals on this list are unlawful except under permit issued by the California Department of Fish and Game. Animal species restricted by the federal government are considered “injurious wildlife” and named in the Lacey Act (50 CFR 16.11-16.15). The U.S. Fish and Wildlife Service has responsibility for regulating the live importation or shipment of these animals.

California's list of Restricted Animals

<http://www.dfg.ca.gov/licensing/pdffiles/fg1518.pdf>

Click on the following link: “Search for a Specific Regulatory Section”

Title: 14

Section: 671

Injurious Wildlife Species List (PDF)

U.S. Fish and Wildlife Service

<http://www.invasivespeciesinfo.gov/laws/main.shtml>

PLANTS

Certain aquatic invasive plants are listed as Noxious Weed Species in Title 3, Section 4500 of the California Administrative Code. Their eradication, control, and containment are regulated by the California Department of Food and Agriculture (DFA). Each species has been given a “pest rating” based on the economic risks it poses to the state. In addition, Division 3, Chapter 3.5, Section 2300 of the California Fish and Game Code restricts all species of the marine alga genus *Caulerpa*. Federally restricted invasive plants are listed in Noxious Weed Act P.L. 93-629.

CDFA Weed List

http://www.cdfa.ca.gov/phpps/ipc/encycloweedia/pdfs/noxiousweed_ratings.pdf

Federal Noxious Weed List (PDF)

<http://www.aphis.usda.gov/ppq/weeds/weedlist2006.pdf>

Appendix G

State and/or Federal Regulated Aquatic Invasive Animals

Scientific Name	Common Name	Group	Habitat	Regulated By
Mustelidae (Family)	All species except <i>Amblyonyx cinerea</i> , Oriental small-clawed otter, <i>Aonyx capensis</i> , African clawless otter, <i>Pteronura brasiliensis</i> , giant otter and all species of genus <i>Lutra</i> , river otters.	Mammals	F	CA
Amiidae (Family)	bowfins	Fish	F	CA
Anguilla (Genus)	freshwater eels	Fish	F	CA
Aplodinotus grunniens (Species)	freshwater drum	Fish	F	CA
Astyanax fasciatus (Species)	banded tetra	Fish	F/B	CA
Belonesox belizanus (Species)	pike killifish	Fish	F	CA
Carcharhinus (Genus)	freshwater sharks	Fish	F	CA
Cetopsidae (Family)	whalelike catfishes	Fish	F	CA
Channidae (Family)	snakeheads	Fish	F	CA, US
Clariidae (Family)	labyrinth catfishes	Fish	F	CA*,US
Ctenopharyngodon idella (Species)	grass carp (permits may be issued for possession of triploid grass carp)	Fish	F	CA
Cyprinodon variegatus (Species)	sheepshead minnow	Fish	F/B	CA
Dorosoma cepedianum (Species)	gizzard shad	Fish	F	CA
Esocidae (Family)	piques	Fish	F	CA
Heteropneustidae (Family)	airsac catfishes	Fish	F	CA
Hoplias malabaricus (Species)	tiger fish	Fish	F/B	CA
Hypophthalmichthys molitrix (Species)	silver carp	Fish	F	CA
Hypophthalmichthys nobilis (Species)	bighead carp	Fish	F	CA
Ictiobus (Genus)	buffalo suckers	Fish	F/M	CA
Lepisosteidae (Family)	gars	Fish	F	CA
Leuciscus idus (Species)	Ide	Fish	F	CA
Morone americana (Species)	white perch	Fish	F	CA
Morone chrysops (Species)	white bass	Fish	F	CA
Perca flavescens (Species)	yellow perch	Fish	F	CA
Potamotrygonidae (Family)	river stingrays	Fish	F/M	CA
Petromyzontidae (Family)	lampreys - all nonnative species	Fish	F/M	CA
Salmo salar (Species)	Atlantic salmon - restricted in the Smith River watershed	Fish	F/M	CA

* Only members of the Clarias, Dinotopterus, and Heterobranchus genera are prohibited by Title 14 section 671

Key

B	Brackish	CA	CDFG Restricted Species, Title 14, Section 671
F	Freshwater	US	USFW Lacey Act 50 CFR 16.11-16.15
M	Marine		

Appendix G

State and/or Federal Regulated Aquatic Invasive Animals

Scientific Name	Common Name	Group	Habitat	Regulated By
Salmonidae (Family)	live or dead uneviscerated salmonid fish, live fertilized eggs, or gametes of salmonids are prohibited unless accompanied by a certification that ensures they are free of <i>Onchocorhynchus masou</i> virus and the viruses causing viral hemorrhagic septicemia and infectious hematopoietic necrosis, and meet the conditions in 50 CFR 16.13	Fish	F/M	US
Serrasalmus (Genus)	piranhas (including genera <i>Pygocentrus</i> and <i>Pygopristis</i> , and invalid genera <i>Serrasalmo</i> , <i>Taddyella</i> , <i>Rooseveltiella</i>)	Fish	F	CA
<i>Stizostedion vitreum</i> (Species)	walleye	Fish	F	CA
<i>Tilapia aurea</i> (Species)	blue tilapia	Fish	F/M/B	CA
<i>Tilapia nilotica</i> (Species)	Nile tilapia	Fish	F/M/B	CA
<i>Tilapia sparrmani</i> (Species)	banded tilapia	Fish	F/M/B	CA
<i>Tilapia zillii</i> (Species)	redbelly tilapia (permits may be issued to a person or agency for importation, transportation, or possession in the counties of San Bernardino, Los Angeles, Orange, Riverside, San Diego, and Imperial)	Fish	F/M/B	CA
Trichomycteridae (Family)	parasitic catfishes	Fish	F	CA
<i>Ambystoma</i> (Genus)	tiger salamanders	Amphibian	F	CA
Bufo (Family)	toads (including <i>Bufo marinus</i> , cane toad, giant toad or marine toad; and invalid species, <i>Bufo paracnemis</i> , Cururu toad, and <i>Bufo horribilis</i> , other large toads from Mexico and Central and South America)	Amphibian	F/M	CA
<i>Xenopus</i> (Genus)	clawed frog	Amphibian	F	CA
Crocodylia (Order)	crocodiles, caimans, alligators and gavials	Reptile	F/M	CA
Chelydridae (Family)	snapping turtles	Reptile	F	CA
Cambaridae (Family)	crayfish - all species except <i>Procambarus clarkii</i> and <i>Orconectes virilis</i>	Invertebrate	F/M	CA
<i>Eriocheir</i> (Genus)	crabs	Invertebrate	F/M	CA, US
<i>Dreissena</i> (Genus)	zebra and quagga mussels	Invertebrate	F	CA, US **
<i>Potamopyrgus antipodarum</i> (Species)	New Zealand mudsnail	Invertebrate	M	CA
Transgenic Aquatic Animals	Freshwater and marine fishes, invertebrates, crustaceans, mollusks, amphibians and reptiles		F/M	CA

** Only the species *Dreissena polymorpha* is prohibited by the Lacey Act

Key

B	Brackish	CA	CDFG Restricted Species, Title 14, Section 671
F	Freshwater	US	USFW Lacey Act 50 CFR 16.11-16.15
M	Marine		

Appendix G

State and/or Federal Regulated Aquatic Invasive Animals

Scientific Name	Common Name	Habitat	Applicable Regulations/Pest Rating
<i>Alternanthera philoxeroides</i>	alligatorweed	F	A
<i>Arundo donax</i>	giant reed	W/U/R	B
<i>Azolla pinnata</i>	mosquito fern, water velvet	F	US
<i>Cabomba caroliniana</i>	fanwort	F	Q
<i>Caulerpa taxifolia</i>	Caulerpa	M	US, DFG
<i>Caulerpa cupressoides</i>	Caulerpa	M	DFG
<i>Caulerpa mexicana</i>	Caulerpa	M	DFG
<i>Caulerpa sertularioides</i>	Caulerpa	M	DFG
<i>Caulerpa floridana</i>	Caulerpa	M	DFG
<i>Caulerpa ashmeadii</i>	Caulerpa	M	DFG
<i>Caulerpa racemosa</i>	Caulerpa	M	DFG
<i>Caulerpa verticillata</i>	Caulerpa	M	DFG
<i>Caulerpa scapelliformis</i>	Caulerpa	M	DFG
<i>Eichhornia azurea</i>	anchored water hyacinth	F	US
<i>Hydrilla verticillata</i>	hydrilla	F	US, A
<i>Hygrophila polysperma</i>	Miramar weed	F	US
<i>Ipomoea aquatica</i>	Chinese water spinach	F	US
<i>Lagarosiphon major</i>	oxygen weed	F	US
<i>Limnobium spongia</i>	spongeplant	F	Q
<i>Limnophila indica</i>	ambulia	F	Q
<i>Limnophila sessiliflora</i>	ambulia	F	US, Q
<i>Lythrum salicaria</i>	purple loosestrife	W/U	B
<i>Melaleuca quinquenervia</i>	broadleaf paper-bark tree	W	US
<i>Monochoria hastata</i>	monochoria	F	US
<i>Monochoria vaginalis</i>	heartshape false pickerelweed	F	US
<i>Nymphaea mexicana</i>	banana water lily	F	B
<i>Ottelia alismoides</i>	duck lettuce	F	US
<i>Pistia stratiotes</i>	water lettuce	F	B
<i>Polygonum amphibium</i>	swamp smartweed	F	C
<i>Polygonum cuspidatum</i>	Japanese knotweed	W/U/R	B
<i>Sagittaria sagittifolia</i>	arrowhead	F	US
<i>Salvinia auriculata</i>	salvinia	F	US, A
<i>Salvinia biloba</i>	salvinia	F	US, A*
<i>Salvinia herzogii</i>	herzog salvinia	F	US, A*
<i>Salvinia molesta</i>	giant salvinia	F	US, A*
<i>Sparganium erectum</i>	exotic bur-reed	F	US
<i>Tamarix chinensis</i>	Chinese tamarisk	U/R	B
<i>Tamarix gallica</i>	French tamarisk	U/R	B
<i>Tamarix parviflora</i>	smallflower tamarisk	U/R	B
<i>Tamarix ramosissima</i>	salt cedar	U/R	B

*DFA considers these species a synonym of *Salvinia auriculata*

Appendix G
State and/or Federal Regulated Aquatic Invasive Animals
Key for State and/or Federally Regulated Aquatic Invasive Plants

DFG Regulated by CDFG Division 3, Chapter 3.5, Section 2300

F Freshwater

M Marine

R Riparian

SM Saltmarsh

U Upland

US **Regulated by the Federal Noxious Weed Act, P.L. 93-629.**

For more details, see the discussion of the Noxious Weed Act in the subsection titled "Other Federal Authorities" in Appendix B of the California Aquatic Invasive Species Management Plan..

W Wetland

Noxious Weed Ratings per California Department of Food and Agriculture Plant Industry Policy Letter 89-2, May 1, 1989. <http://www.cdffa.ca.gov/cdfa/pendingregs/docs/PlantPestRatings.pdf>

A An organism of known economic importance subject to enforced action involving eradication, containment, rejection, or other holding action at the state-county level. Quarantine interceptions to be rejected or treated at any point in the state.

B An organism of known economic importance subject to eradication, containment, control or other holding action at the discretion of the commissioner. OR an organism of known economic importance subject to state holding action and eradication only when found in a nursery.

C An organism subject to state endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the commissioner; reject only when found in a cropseed for planting or at the discretion of the commissioner.

Q An organism requiring a temporary "A" action pending determination of a permanent rating. It is suspected to be of economic importance, but its status is uncertain because of incomplete identification or inadequate information.

D Organisms determined to be of little or no economic importance